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ELECTRICAL WORLD AND ENGINEER.

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THE UNION ENGINEERING BUILDING.

Stage by stage the great Union Engineering Building project, due to Mr. Andrew Carnegie's munificence, advances to successful issue. The American Society of Civil Engineers, at its meeting last week, decided to canvass its members, and although many objections to union were raised, it is hardly to be believed that the civil engineers of the country will want to reject their share of the gift or imperil that of the sister societies, especially after Mr. Carnegie has just added $500,000 to the original $1,000,000 in order to take full care of the necessities of all the societies, if the Civils should "come in." However, in its broadest aspect, the matter is now "up to" the Civils; and we do not hesitate to say, knowing whereof we speak, that the Electricals count confidently upon their co-operation. In the early days of struggle, the Electrical Engineers were fostered by the Civils and always made at home at the old house in East Twenty-third Street; and it is sanguinely hoped thus to cultivate again at no distant date, in a grander, more splendid, more comfortable, place, the close fellowship of the past.

The Civils have been told that if they do not come in the project thereby falls to the ground. Should this be true, their responsibility would, indeed, be great, and we have no objection to their understanding it in that manner. But it is not true, and it is best that at each stage there should be the fullest light and understanding on the scheme. President Noble last week quoted apparently a remark of Mr. Carnegie, that he was likely to have five lots on his hands; but that Mr. Noble gravely misunderstood him seems at once evidenced, by the fact that last week also Mr. Carnegie acquired another lot, making, we believe, six in all, and bringing his generous investment in land which he is carrying for the societies—over and above the million and a half—to more than $600,000. It will be seen that this fact and Mr. Noble's theory, anxiously put forward by him to help bring his fellows into line, are not consistent or harmonious.

The various bodies can rest assured that Mr. Carnegie does not propose to see his magnificent ideas and purposes frustrated; it would be the first time in his history. Moreover, it would present the spectacle of a strong and wealthy society deliberately reaching forth its hand to prevent other societies less well off, but able to apply the endowment very beneficially, from receiving a single cent. That aspect of the case has only to be mentioned to show its improbability not less than the sinister interpretation the wide, outside world would bestow on such an action. The renewed and extended primacy in engineering matters which belongs to the Civils and has been deservedly won, will, by acceptance of the gift, be one of the brightest of auguries alike for the wider influence of the society and for the future of the profession.

NORTHWESTERN ELECTRICAL CONVENTION.

Elsewhere we print that part of the proceedings of the convention of the Northwestern Electrical Association not convered in the telegraphic report which appeared in our pages last week. As will be seen, the character of the papers read and the interest manifested in the proceedings show no falling off from the previous meetings of this flourishing association. As has almost invariably been the case in recent years when it came up, the topic which appeared to appeal most directly to the audience was that of central station auxiliary

heating service. Indeed, at the meetings of all the associations representing the smaller central stations, this subject, when on the programme, arouses, judging from its lively discussion, even more interest than the most timely electrical topic. From the experiences related in such discussions it appears that the distribution of heat in connection with a lighting service can, without doubt, be made a profitable business in smaller towns and cities if a proper plant is installed and intelligently managed, and adequate rates are charged. Another advantage of such an appendage to a central station plant pointed out at the convention is that the combination offers a safeguard against the intrusion of a competitor in the lighting field, and the establishment of a municipal electric plant. In view of this situation the interest taken is well justified, and smaller central stations everywhere should not neglect to examine into the advisability of adopting heat distribution in connection with their lighting business.

ALTERNATING-CURRENT POWER CURVES.

It is known that when an alternating e.m.f. drives an alternating-current in a circuit, the power pulsates between a maximum and zero in the non-inductive condition, or between a maximum positive and lesser maximum negative quantity, when the load is inductive. The pulsation of power has twice the frequency of either alternating pressure or of the alternating current. Mathematical proofs of this proposition by several writers are to be found scattered through the polyglot literature of alternating-current technology. An additional demonstration is given in an article on page 215 by Mr. W. J. Berry. It follows that if a wattmeter mechanism could be constructed of sufficiently small periodic time, it would pulsate with twice the frequency of the generator assumed as bipolar. If this wattmeter mechanism drove a new bipolar generator, the frequency in its circuit would be double that of the first generator. By successive concatenations of wattmeter mechanisms to generators, the frequency might be redoubled indefinitely. Such an arrangement is probably quite impracticable, but it forms an interesting ideal method of frequency multiplication. The late F. Jarvis Patten at one time took up the investigation of the subject and devised some ingenious means for arriving at practical results.

ELECTRICAL FOUCAULT PENDULUM SYSTEMS.

The name of Foucault is not only associated with eddy currents, or electric whirls, in metallic masses, but also with the demonstration of the variation of the plane of vibration of a pendulum. The public demonstration which he made in 1851 at the Paris Pantheon, by swinging a pendulum from the dome, dominated popular fancy, and perhaps first made clear to the ordinary conception the rotation of the earth about its axis. His pendulum consisted of a 28-kilogram bob suspended by a steel pianoforte wire from the dome ceiling. The length of the pendulum is recorded as 67.21+ meters, so that the time of a single swing was 8.2 seconds, or 16.4 seconds for the complete period. There were thus less than four complete swings per minute. The angle of initial displacement was about 10°, and the pendulum was started from this displacement by burning the deviating thread. At a radius of four meters a ring of sand was raised, which was chiseled by a point on the bottom of the swinging bob. If the pendulum had been erected at the North Pole it would, naturally, tend to swing in its original plane, while the earth moved around beneath it, thus bringing the entire ring of sand through one complete revolution in 24 hours. This would mean an apparent advance of the bob along the sand at the rate of 25.13 meters in 24 hours, or 1.047 meters per hour, or 1.744 centimeters per minute; or 4.77 millimeters per complete swing. But the Pantheon at Paris, instead of being at the North Pole, or in latitude 90°, was in 48° 50′ 49″ north latitude, according to the record, and the deviation of the plane of vibration would be less than that at the Pole in the ratio of the sine of this latitude, or 0.7529. This would reduce the cut into the sand at each successive swing from 4.77 millimeters to 3.59 millimeters (about one-seventh of an inch), and the observed rate of cutting is said to have agreed with this result.

The trouble with this beautiful experiment was naturally the continual diminution of the successive swings. The rate of decrement is not stated; but the original stock of energy being limited to about 2,800 megergs at 10° original deviation, the continual frittering away of this energy in air friction and wire bending would soon greatly enfeeble the swings. Consequently, charming and instructive as the demonstration must have been, it was necessarily but short-lived. Real luxury in such a case would be to restore energy to the swinging bob without perplexing it, or affecting its plane of vibration, and thus to keep it going at full amplitude indefinitely. At the end of 24 hours the bob should have cut down the little sand bank to the extent representing the sine of the latitude, or 75.29 per cent. of a complete rotation in relative space. Probably elaborate precautions against tremors and air currents would become necessary in making the measurement under such ideally luxurious conditions. But after due care had been expended in safeguarding the plane of vibration from accidental disturbance, the perennially-reinforced pendulum ought to work out its own latitude very nicely in this way.

Another form of the mechanical system capable of revealing persistence of motion is the gyrostat, or rapidly-revolving small flywheel, whose axis tends to remain in the original direction, and to permit all terrestrial things to move around according to the earth's rotation. In fact, the pendulum may be looked upon as a particular form of the gyrostat, in which the rotation is incomplete and oscillatory. Of course, the gyrostat also suffers from the decay of initial energy, and only scorns the earth's movement for but a brief interval. The problem of reinforcing a gyrostat or pendulum, without disturbing its plane of vibration, has been considered by various writers, and electrical means have been favorites. It seems almost impossible to restore energy by mechanical force, through the medium of any contact with the moving parts, without at the same time exerting a bias or disturbing force on the plane of vibration. For example, the ordinary pendulum clock restores enough energy at each beat of the pendulum, from the mainspring or driving weight, to make up for the loss during the preceding beat; but in this case the plane of the pendulum is kept definite and moves around with the earth.

In the article on page 211 Mr. E. K. Adams considers various electromagnetic pendulums, and suggests a variety of ingenious electric expedients for maintaining the amplitude of vibration. It is, of course, hard to foresee the minor difficulties that may arise in the operation of such devices, but it would be very interesting to develop a working apparatus of this kind. At least one of the forms described should be capable of operating successfully. Such an apparatus, actually maintaining itself at full amplitude of vibration for a day at a time, would be both interesting and instructive; but its utility would be seemingly confined to interest and instruction. Any apparatus, however, which could be devised to operate automatically in spite of jars, or swings of its support, would, if not too expensive, be of great practical value. Possibly it would be hopeless to control the pendulum on board a rolling ship at sea; but it might be within the range of possibility to work a gyrostat electrically at a very high speed, so as to retain its direction of motion in gimbals, regardless of the behavior of the ship. If this could be done, the navigator, by running the apparatus during a

measured time, might be able to compute the latitude, from the deviation of the plane of motion, by compass, during that period. Such a plan, if it could be made effective, would be available for latitude observations at sea, in fog, or darkness, or near the land.

ELECTRIC CONVECTION.

The December number of the *Physical Review* contains an important report by Messrs. Cremieu and Pender on the magnetic effect of electric convection, the conclusions of which we printed last week, and to which, owing to the unusual interest of the subject, we now return. The fundamental theory of electromagnetism declares that there are two kinds of electric currents, namely, currents of conduction, such as are guided by a wire forming a closed conducting circuit, and currents of displacement, such as are formed by electrostatic displacement in a dielectric. The conduction current is typically presented in a direct-current circuit, while a displacement current is presented in a condenser connected to an alternating e.m.f. The characteristic requirement of a conduction current is a wire or conductor. The characteristic requirement of a displacement current is an insulator subjected to a variation of electric force. It is also fundamental that whatever the nature of a current of given strength, by conduction, or by displacement, the magnetic effect is the same. An ampere of displacement current entering a condenser will have the same magnetic behavior as an ampere of conduction current in an overhead wire, allowance being made for the different geometrical distribution in the two cases.

In fact, we may be said to know that a conduction current is of the same nature as a displacement current, for the latter is a production of electric flux in a dielectric by electric charge, or electric potential difference; and the former is a movement of electric flux in a dielectric surrounding a guiding conductor. In a condenser, the varying electric flux which constitutes a current, is due to the variation of potential between the two opposed surfaces. In a direct-current circuit, the electric flux changes by running along the wire. Magnetic action accompanies change or motion of electric flux, and it should not matter how the change in electric flux is produced. The magnetism merely depends upon the change. If we take a charged body, say an electrified gilded billiard ball suspended by a silk thread, we know that electric flux emanates from the ball radially in free space, and very nearly radially in the middle of an ordinary room. When we move the electrified ball, as by swinging it, the electric charge moves also, and the electric flux moves conformably. That is, flux permeates the air in regions that were not previously permeated to the same degree, and vacates other regions that were previously more thoroughly permeated. This means, according to accepted theory, the establishment of displacement currents. It also means, by the same theory, the production of magnetic action in the neighborhood, during the motion. Consequently, when the electrified ball is stationary, there will be electric flux at rest, but no current and no magnetic action. When the ball is moving, there will be both current and magnetism. Moreover, the current and magnetism should increase in intensity with the speed of movement.

Maxwell predicted this result in 1873. The late Prof. Henry Rowland published experimental results in 1878, showing that the magnetic effect of a moving charge existed. It was commonly called the Rowland effect. Rowland rotated a disc with a charged conducting surface inside a box, and delicately supported a magnetic needle over the rotating disc outside the box. When the rotating disc was charged, or grounded, or reversed in electrification, the magnetic needle behaved in reasonable accordance with theory. It would be a serious matter for the present electrical theory if the effect could not be found. In fact, it may be said that if persistent effort showed that the magnetic effect of electric convection did not exist, it would kill the theory, and the death of the theory would upheave all our notions concerning electricity, which have been slowly and steadily put together by more than a century of the world's electrical labors. In 1884, however, Lecher tried the experiment in a somewhat different way, and failed to detect the effect. The magnetic effect to be expected is, however, very feeble at any speed and electrification that can be conveniently employed in a laboratory; so that the fact that a single observer did not obtain the effect, did not make electricians feel very uncomfortable, seeing that one good observer said he had found the effect. Negative evidence is not nearly so definite as negative electrification. Röntgen tried the experiment in 1885 and reported that he obtained the effect. Prof. Rowland and Dr. Cary T. Hutchinson repeated Rowland's original experiment in 1889, on an enlarged scale. They employed a pair of discs running in condenser boxes at high speeds, and with delicate magnetic needles outside. The effect was obtained within about 6 per cent. of its theoretical amount, the maximum variation being about 25 per cent. above or below. Prof. Himstedt took up the experiment about the same time and obtained the effect in a substantially similar manner.

So far only one observer of known ability had failed to obtain the effect. But in 1897 M. Victor Crémieu, of Paris, took up the experiment, or rather a whole series of experiments, and failed to get the effect. He went so far as to say, in 1901, that the effect was a myth. Theory showed that the effect was very minute under laboratory conditions; but positively declared that it must be there. So when Crémieu declared that the effect was certainly not there, consternation awoke. Crémieu worked for several years on the question and kept publishing papers to show that his experiments were all negative. In 1901 Pender, under Rowland's directions, repeated Rowland's experiments and made a long research into the matter, using a pair of discs revolving at high speeds. He obtained the effect within 2 per cent. of the theoretical amount, and within a maximum variation of 8 per cent. Pender kept repeating his experiments and getting the effect on this side of the Atlantic, while Crémieu kept repeating his experiments and not getting the effect on the other side of the Atlantic. Eichenwald, in Europe, recently repeated Rowland's experiment, with certain modifications, and got the effect, while Adams, in England, rotated electrified spheres, fastened to the spokes of a pair of wheels, and also obtained the effect.

In 1902 Poincaré suggested that Pender, who always got the effect, should meet and collaborate with Crémieu, who always did not get it, so as to arrive at a joint result. Lord Kelvin suggested that the joint research should be made in Paris. Johns Hopkins University placed the apparatus used by Pender at his disposal for transportation, and the Carnegie Institute defrayed the expense of his journey. M. Bouty placed his laboratory in the Sorbonne at the disposal of the two investigators, while the expense of their experiments was met by the Institute de France. The two men worked together for about three months. They finally report jointly that the effect is found. Incidentally, they trace the negative results previously obtained by Crémieu to the influence of certain thin layers of solid insulating material fastened to the surfaces of the revolving electric conductor. Just how these insulating covers prevented the effect is not clear, but it will probably be investigated. The real value of the joint report of Crémieu and Pender, recently published, lies not only in the final establishment of the magnetic effect of a moving electric flux, as required by theory, but also, and more particularly, in the international co-operation of scientific organizations to bring about this result. This international scientific co-operation is of enormous potential importance, and every effort should be made to foster it. Electrical science owes much to both of these joint observers for their collaboration.

Institute Annual Dinner.

Notices have been issued this week to members of the American Institute of Electrical Engineers, with regard to the annual dinner at the Waldorf-Astoria on February 11. As already stated, the price of tickets for gentlemen, without wine, is $7, and for ladies, $5. In addition to this, provision is also being made for admission to the boxes in the galleries of the ballroom at $1 per ticket. Mr. Calvin W. Rice, chairman of the committee, believes that a large number of persons will be glad to avail themselves of the opportunity thus to be present at a function which takes on a rather more historical and memorial character than the ordinary banquet, and it is not unlikely that the galleries may be filled with quite a large audience in addition to the guests at dinner on the main floor. It may be noted as an item of news that the menu being prepared will include a fine portrait in colors of Mr. Edison, being the gift to the Institute for that purpose by the New York Edison Company.

The Edison Medal Association is, of course, co-operating actively in the plans for the dinner, and many subscribers to the Fund, not members of the Institute, will be present. A large number of subscriptions to the Institute Edison Medal have been received, and the fund is already an assured success; but it is desired that it shall reach the full sum set forth in the circulars, in order that liberal provision for the foundation may be made in every respect. The suggestion has reached the Association that many of those who derive their living from the industries created by inventions in the lighting field would like to contribute also to the Fund, and the Association has prepared lists which are obtainable by companies desiring thus to contribute to the Edison Medal, the first, it is said, which has ever been offered in the field of electricity as an encouragement for studious and ambitious young men. Amounts of $1 and less will be received, and the lists of names will be bound into the album which it is proposed to give Mr. Edison containing the autographs of all the contributors.

Equipping the Erie Canal Electrically.

The question of equipping the Erie Canal electrically is just now attracting a great deal of attention, especially as a result of the tests described recently in these pages. Mr. Charles S. Boyd, superintendent of public works, believes that he can grant an indeterminate right to the International Towing & Power Company to install a similar electric towing plant the entire length of Champlain Canal. But in the first place, the law of 1893 permits him to allow only the temporary erection of a towing plant for testing the "efficiency, economy and practicability" of such device. It conveys no power which would enable any experimenters to do business and charge tolls. In the second place, the law restricts the experiments to corporations "authorized to transact business within this State," and this authorization, it is said at the Secretary of State's office, the towing company mentioned has not received. In the third place, the State Constitution forbids the lease, sale or other disposition of the canals. This is construed to mean that the canal banks, beds, towpaths, etc., are to be kept in the possession and management of the State forever, and that no exclusive privilege to do towing could be granted.

It is contended on behalf of Mr. Boyd's position that Section 38, Article 3, Chapter 338, Laws of 1894, gives warrant for his point of view. This provides that "the Superintendent of Public Works may authorize from time to time any person or corporation to construct, maintain and operate electric conductors for light, heat or power upon or along any canal, on such terms and conditions, not inconsistent with the public use of such canal, as he approves; in like manner contract for or permit the use of such light, heat or power upon any such canal, but not to create a charge against the State except against appropriations lawfully applicable thereto."

Justice Herrick's recent decision, enjoining a man from cutting ice on the canal without a permit from the Superintendent of Public Works, seems also to recognize the large power of that officer over the canals. He may grant or refuse permission to cut ice wherever he wills.

Precedent for the giving of a permit to an electrical towing company is indicated in the case of the Cataract Electric Company. In 1894 Superintendent Hannan issued a permit to that company to put up pole lines, etc., along the canal.

The Automobile Club Annual Dinner.

The Automobile Show in New York City came to a most successful close last week, the attendance being estimated at 50,000 and upwards, while the sales are also reported to have been very large. A fitting finale was given by the annual dinner at the Waldorf-Astoria on Saturday night, attended by over 300 guests, with about 100 ladies in the boxes, in addition. A notably large number of electrical men were present, and Mr. T. A. Edison occupied a prominent seat at the speakers' table. The decorations and electrical effects were admirable. The speaking also, under the skillful guidance of President Scarritt, was excellent. The keynote of the evening, as usual, was "good roads," and hearty endorsement was given by speakers and audience alike to the Brownlow measure now before Congress to spend $20,000,000 on the betterment of the main roads of the United States. Among those present were Messrs. L. R. Alberger, W. H. Baker, W. G. Bee, Hart O. Berg, E. T. Birdsall, N. F. Brady, A. H. Chadbourne, G. H. Day, C. J. Glidden, W. C. Gotshall, J. M. Hill, John A. Hill, Walter H. Johnson, W. C. L. Eglin, F. A. La Roche, T. C. Martin, Lewis Nixon, P. T. Dodge, A. R. Pardington, A. L. Riker, Henry Sanderson, J. Seligman, Angus Sinclair, E. L. Powers, H. M. Swetland, R. A. C. Smith, A. H. Whiting, C. C. Worthington and others in the electrical and allied fields.

World's Fair Electric Railway Test Commission.

A second meeting of the Electric Railway Test Commission of the Universal Exposition, St. Louis, 1904, convened in New York on January 27, 1904. All of the commissioners, namely, Mr. J. G. White, chairman; Mr. H. H. Vreeland, Mr. James H. McGraw, Mr. George F. McCulloch, Mr. W. J. Wilgus, were present, and a great deal of work was accomplished in furthering the plans for an elaborate series of tests of electric railway equipment at the Exposition. Much interest has been manifested by electrical engineers in the proposed tests, and the value of the engineering data which in all probability can be accumulated in this way, is not to be overestimated. The tests will undoubtedly have the effect of greatly stimulating interest in electric railway undertakings and promoting development along the lines best adapted to meet effectively the conditions most prominent in different classes of service.

The work has been divided into four main divisions, and special committees of engineers, who are specialists in the several divisions of electric railway work, have been appointed to prepare a schedule of the tests which will be made of the equipment offered in each class. These special engineering committees on the scope of the tests will take cognizance of the following branches of work: City and suburban equipments, interurban equipments, heavy traction equipments, new systems of electric traction. The committees are expected to prepare and submit preliminary reports to the commission on or before February 22, and the next meeting of the commission will take place in New York City, on Monday, February 29, at which time the reports of the special committees will be reviewed and passed upon.

High Speed in Germany.

A special cable dispatch from Berlin, of January 26, says: "Before the budget committee of the Prussian Diet to-day, Minister of Public Works Budde, discussing the recent electrical rapid transit experiments, said:

"The studies are still in their preliminary stages. We cannot undertake the transportation of the general passenger public electrically. It is still uncertain whether such roads can be economically profitable. The experiments will be continued with necessary precautions. The operation of the suburban road from Berlin to Grosslichterfelde gives the most favorable results, and we shall soon see the practical introduction of electricity on the Hamburg Elevated Railroad. The Prussian Railroad Administration will utilize the results of all these experiments."

The Siskiyou Power Transmission.

THE power house of the Siskiyou Electric Power Company is situated on Fall Creek, a tributary of Klamath River, eight miles from the well-known Klamath Hot Springs, two miles south of the Oregon line, in California, and twelve miles from Lairds, on the main line of the Southern Pacific Railway traversing California and Oregon. The power house is situated within 300 ft. of the Klamath Lake Railway, which made it very convenient for getting supplies on to the ground for the construction of the power house, pipe line and other work. The water for the operation of the plant is delivered from two creeks; one, Fall Creek, so named from the beautiful water falls along its course, supplies 1,500 miners' inches; and the other, Spring Creek, so named from the fact that its source of supply is in a great spring, supplies 700 inches. These creeks might have been named from the two respective seasons to denote that their water supply is continuous through spring and fall, as the flow of 2,000 miners' inches is uniform the year around. The supply appears to come from the drainage of a large area of tableland extending over thirty miles, where no water courses are to be found outside of these two creeks, which are evidently the drainage of this territory. Their chief peculiarity, however, is the fact that they do not freeze in winter because of their origin in and transit through a volcanic country.

A small wingdam has been built across Spring Creek for diverting the water into a 3,000-ft. ditch, which carries it first through a backbone of a mountain and thence to the main channel of Fall Creek. This ditch is 3 ft wide at the bottom, 6 ft. at the top, 3½ ft. deep and is built on a grade of 5 ft. to 100 ft. The course of Fall Creek ditch lies almost entirely through rock of volcanic formation, and it begins one mile above the upper falls of Fall Creek, from which it takes water by means of a diverting dam 115 ft. long and 4 ft. high. Very little work was necessary to put in this dam, as all natural conditions were favorable to it. The Fall Creek ditch is 4,650 ft. long, being 6 ft. wide at the bottom, 5 ft. deep and 12 ft. wide at the top, built on a 5 per cent. grade. The velocity is 3¾ ft. per second, which gives the ditch a capacity of 2,000 miners' inches. The only piece of flume in the work is a stretch of 96 ft. leading from the ditch to the penstock, it being 6 ft. wide by 4 ft. high and laid on solid rock. The penstock is solidly built on a cement foundation, laid on 12 by 12 timbers; that is, 14 ft. square by 16 ft. deep, and its walls are made up of 2-in. plank 6 in. wide, piled up flat one above the other. This wall is lined with a ⅛-in. coating of P. & B. roofing material, after which it is surfaced with 2-in. tongue and groove flooring. The whole penstock is braced with rods and turn-buckles extending diagonally across its section; finally it is painted inside and out with P. & B. paint and roofed over.

The pipe line is made of double-riveted steel pipe in the following lengths, the enumeration beginning at the penstock and extending downward: 37 ft. of pipe, 40 in. tapering to 30 in., of No. 10 gauge steel; 800 ft. of pipe, 30 in. No. 10 gauge steel; 700 ft. of pipe, 30 in. No. 6 gauge steel; 800 ft. of pipe, 30 in. ¼-in. steel; 500 ft. of pipe, 30 in. ⅝-in. steel.

The receiver is 60 ft. long, 30 in. in diameter, and made of 7/16 steel. From it there are taken three 12-in. taps for the respective three water wheels. From penstock to nozzle the head is 715 ft., giving a static pressure of 310 pounds to the square inch. A 30-in. hand-operated gate, which weighs 12,000 pounds, and which is provided with a 4-in. bypass gate, is inserted in the pipe line in the manner shown in the accompanying illustration, before the pipe line enters the receiver.

FIG. 4.—DIVERTING DAM.

The power house is constructed of a light steel frame, covered with corrugated iron. The main building is 30 ft. by 57 ft. in ground area, and the transformer room, which is separate from it—a similar building—measures 14 by 20 ft. in size. A 7-ton traveling crane runs the entire length of the main building, the latter being designed to contain three generator sets, one of a capacity of 500 kw and the other two to be of a capacity of 750 kw each.

At present there is installed one 2,300-volt General Electric generator, direct-connected to a 62-in. Pelton water wheel of two bearings and with a flexible coupling. This water wheel has a capacity of 1,000 hp. The whole is set on a concrete foundation built up of one part cement, two parts of sand and three of gravel, extending 8 ft. below the surface of the ground, which is of the ordinary lava

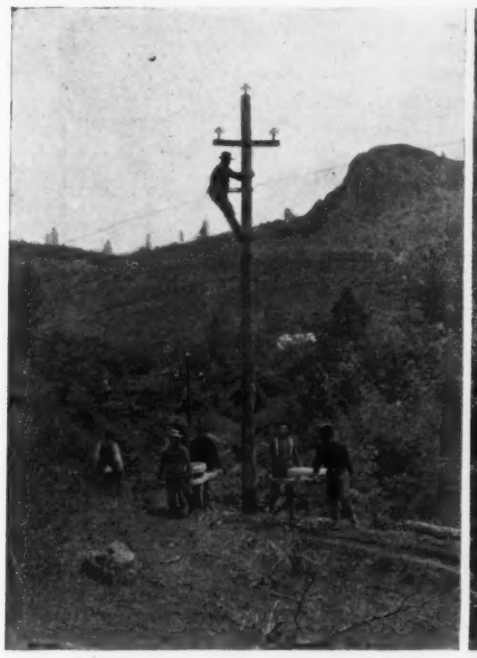


FIG. 1.—POLE LINE CONSTRUCTION.

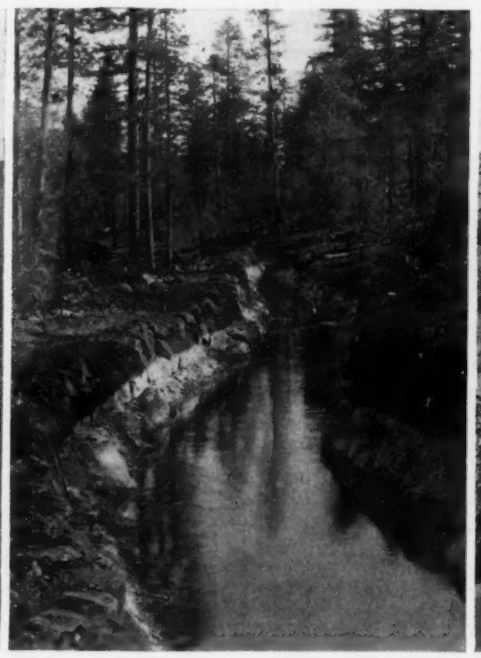


FIG. 2.—VIEW OF MAIN DITCH.

FIG. 3.—GATE VALVE.

formation mixed with a sort of cemented clay. A Lombard governor controls the generator, the exciter for which is a 125-volt General Electric generator, run by an 18-in. Pelton water wheel that overhangs on the exciter bearing. The switchboard consists of one main generator panel, one exciter panel, and one low-tension panel, all being provided with oil switches and everything in connection with the switchboard being of latest General Electric design.

The transformer house contains three General Electric water-

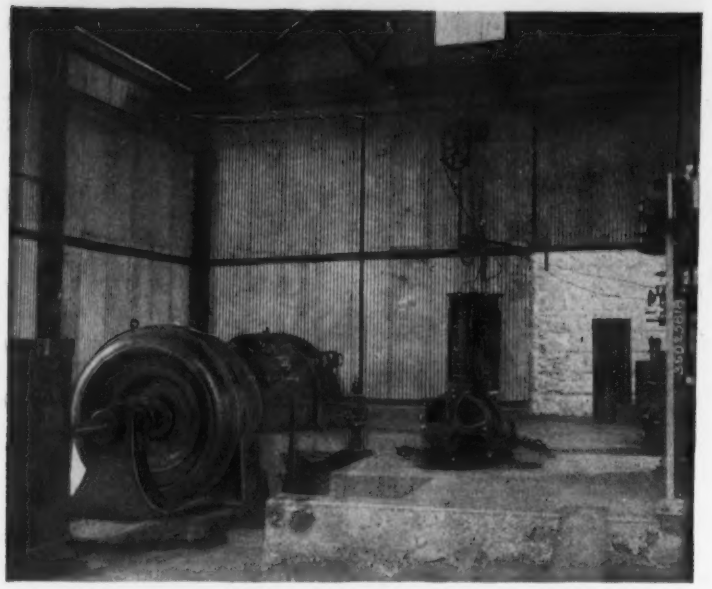


FIG. 5.—FIRST GENERATOR INSTALLED.

cooled transformers having a capacity of 167 kw each, the primary voltage being 22,500 and the second voltage being 2,300. There are also installed in the transformer house three lightning arresters and one high-tension oil switch panel.

The circuit extends in a direct line running southwest from the power house on Fall Creek to Yreka, a distance of 22 miles, whence it continues on in another direct line tending west by southwest, passing the base of Humbug Mountain to New York Mine, 14 miles beyond Yreka. Almost due south of the New York Mine and separated 7 miles from it by way of the pole line is Fort Jones, whither the line also reaches, thus making the total length of the main line

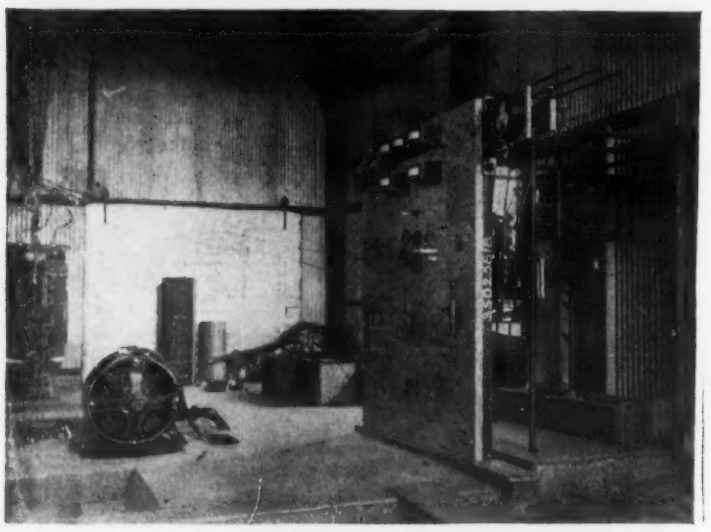


FIG. 6.—POWER HOUSE SWITCHBOARD.

to be 43 miles. The Hornbrook line is tapped from the main line at its crossing over Bogus Creek, which is a little less than one-half the distance from the power house to Yreka, and just before entering Yreka another branch line, which runs to Montague, a station on the Southern Pacific line to Oregon, is tapped off the main line. From Montague this extension is continued on across the base of Mount Shasta in a direct line to Little Shasta Mill. The length of the Hornbrook branch is six miles, while that of the Montague branch is close to 14 miles. All the line is of aluminum three-strand No. 4 cable, using Locke insulators with glass top and petticoat, and designed for a working pressure of 40,000 volts. The pins are eucalyptus, 1½ in. x 12 in. in size and are boiled in oil. The cross arms are of Washington fir, boiled in oil and painted. The poles are round, of red fir, 30 ft. long, with 7-in. iron-shod tops, creosoted at the butt and in some places tarred.

Current was turned on September 12th, and the business consists of both lights and power service. The towns of Montague, Yreka, Fort Jones and Aetna in California are already supplied, while Ashland, Medford, Jacksonville and Phœnix in Oregon will be supplied with electric service. The plant was started with 300 lights at Montague, 400 lights at Fort Jones, 75 hp at the New York Mine, and 125 hp at Punch Creek, near Yreka. Besides lighting and general industrial power service, a large power field will be found in the mines now operating, and which hitherto have been only prospective,

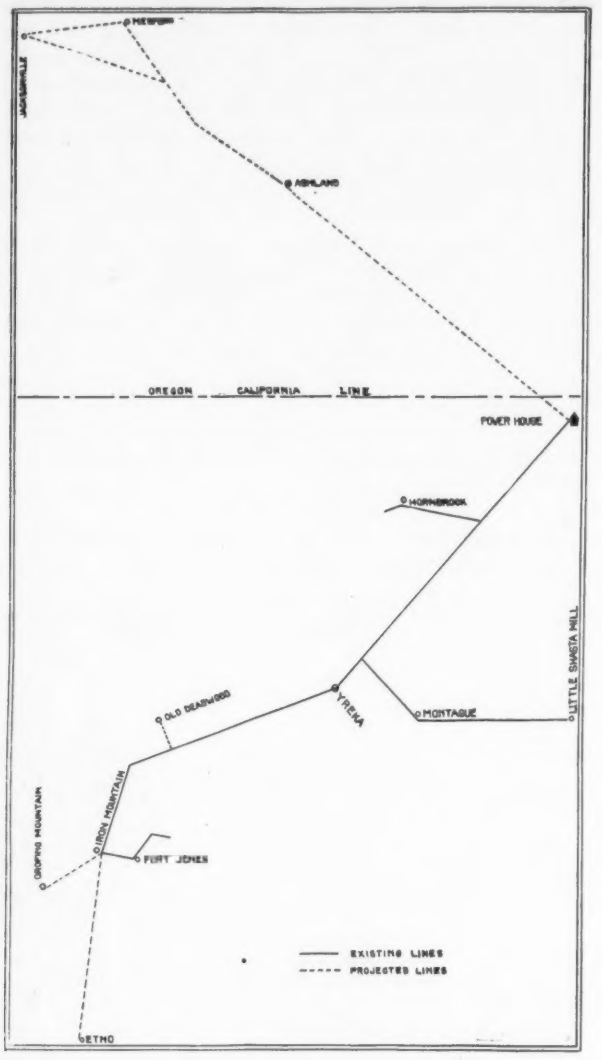


FIG. 7.—MAP OF ROUTE OF LINES.

due to the lack of economical and convenient power. Another field which will take up a large amount of power, although in small units, will be pumping for irrigation. Large tracts of land, that are not now under cultivation, have an abundant supply of water within 10 or 12 ft. of the surface and with electric power these lands will be brought into commission through pumping. Considering the reliability of the water supply and the rich country that is reached by the pole lines both present and prospective, a large and prosperous business is undoubtedly in store for the company.

Telephone Distress Signal.

A correspondent at Indianapolis states that at Anderson, Ind., the Farmers' Telephone Company has adopted a general signal of distress for its patrons on party lines. Following the general alarm the exchange operator will give the number of rings indicating the house from which the alarm came so that the neighbors may go direct to the place where assistance is needed.

Electrical Foucault Pendulum Systems.

BY ERNEST K. ADAMS.

FOUCAULT'S pendulum demonstration of the rotation of the earth, which was first carried out on a large scale in the Pantheon at Paris in 1851, is perhaps one of the most interesting experiments that physics affords, for it demonstrates to the observer the absolute revolution in space of the earth; not that relative motion which one sees when looking at the firmament on a clear night, but a positive turning of the earth in a certain direction with respect to the celestial sphere. The repetition of Foucault's pendulum demonstration in the Pantheon by M. Camille Flammarion, approximately fifty years after the original, has renewed the interest in the same, and has influenced physicists about the world to again carry out the experiment. The pendulum, however, is limited by the fact that in the course of a short time, depending upon the length of the vibrating system, the oscillations cease.

To overcome this disadvantage and thereby provide a means of prolonging the motion of the pendulum, or maintaining the same in constant vibration, are the purposes of the accompanying designs. The sensitiveness of a Foucault pendulum is well known, but it is

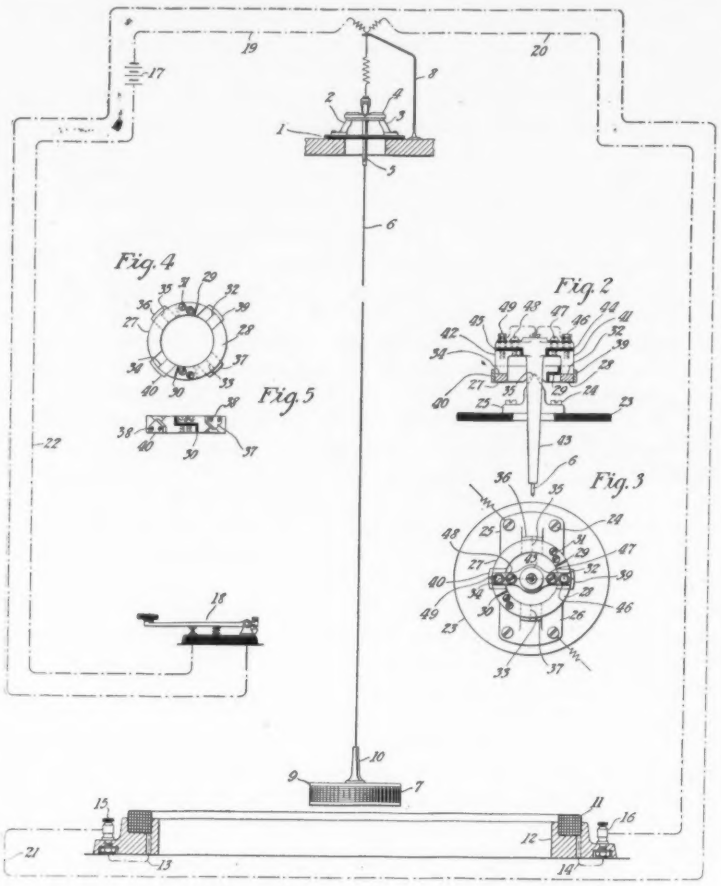


FIG. I.—KEY-CONTROLLED TYPE OF FOUCAULT PENDULUM.

believed that, under suitable conditions, the acceleration may be satisfactorily accomplished, the present designs being herewith presented, both as suggestions for a line of laboratory investigation in this subject, and as convenient adjuncts in physical lectures or other demonstrations. The accelerating principle of the systems is based upon the electrodynamic action of two coils of different diameters, the smaller of which is incorporated in the bob of the pendulum, while the larger is mounted beneath and symmetrically with respect to the aforesaid pendulum. When direct or alternating currents are allowed to simultaneously flow in the two coils in the same direction, it has been found by experiment that the pendulum coil is urged toward the center of the large coil. This action takes place in whatever plane of oscillation the pendulum coil vibrates, and is strongest when the said coil is directly over a portion of the large coil. In the following designs this principle, which allows of accelerating Foucault pendulums without any material contact therewith, has been incorporated, and a number of methods developed for controlling the accelerating action.

KEY-CONTROLLED TYPE.

In this form of electrical Foucault pendulum, the circuit of the accelerating coils is intended to be manually controlled at a key, which is closed when the pendulum bob is traveling toward the center of the large coil. The frequency with which the key should be closed depends upon the length and weight of the pendulum system, the amplitude of the same, the dimensions of the accelerating coils and the strength of the current employed.

By reference to the drawing, Fig. 1, is a diagram of the system, while Figs. 2 to 5, inclusive, show the details of a modified suspension.

The pendulum system primarily consists of a sensitive knife-edge suspension, which is made up of a base plate, 1, two fixed knife-edges, 2 and 3, rocking ring, 4, and central oscillating member, 5. The base, 1, of the suspension is secured to any support, which is both free from vibration and gives the desired height for swinging the pendulum. Passing through the central member, 5, is a flexible twin concentric conductor, 6, which, secured in the aforesaid member, 5, by tying a knot in it, proceeds downward to the pendulum coil, 7. In order to introduce current into the suspension and yet allow it to vibrate without friction, the twin conductor, 6, is coiled before entering the aforesaid suspension, and, furthermore, suspended above by a small wire standard, 8. The coil, 7, is wound upon a wooden spool, 9. A metal post, 10, bolted to the center of the spool, 9, receives the twin conductor, 6. This conductor, 6, is fastened in the post, 10, by tying a knot in it, or by the employment of some other suitable fastening device. The two wires of the twin conductor, 6, are connected with the terminals of the coil, 7, through suitable openings, which are cut in the spool, 9. Located upon any suitable horizontal surface beneath the pendulum is the stationary coil, 11, which is supported in a wooden mounting, 12. The terminals, 13 and 14, of the coil, 11, are respectively connected to two binding posts, 15 and 16, secured to the mounting, 12. The large coil, 11, is accurately adjusted with respect to the pendulum system, so that the center of the said coil, 11, will be directly under the geometric point of suspension of the pendulum. The adjustment is furthermore so made that the clearance between the spool 9 and coil 11 will be a minimum and constant amount in whatever plane of oscillation the pendulum may vibrate.

The wiring of the system consists in placing the two coils, 7 and 11, in series with a source of current, 17, and controlling key, 18, the circuit being made up, from the aforesaid source, 17, of a wire, 19, one of the members of the twin conductor, 6, pendulum coil, 7, other member of the conductor, 6, wire 20, post 16, conductor 14, stationary coil 11, wire 13, post 15, conductor 21, key 18 and wire 22. As already stated, the current should simultaneously flow in the same direction in the two coils, 7 and 11. Having set the pendulum in vibration in the plane of the meridian by burning a thread in the usual manner, the said thread being tied to any suitable support and the pendulum spool, 9, the pendulum may be maintained in constant vibration, throughout its changing plane of oscillation, by pressing the key, 18, when the pendulum coil, 7, is traveling toward the center of the large coil, 11. In this manner an acceleration may be given to the pendulum without materially interfering with the earth's action upon the same. It will be found that a continual pressing of the key, 18, will hardly be required. On account of the arrangement of the accelerating coils, 7 and 11, of the system, alternating current may be employed for operating the pendulum in place of direct current. It may be found that by suitably proportioning and making the spool, 9, and mounting, 12, of iron, the dynamic action will be increased. In that case, if alternating current is employed, the spool, 9, and mounting, 12, should be divided in one or more places for preventing the induction of heating currents therein.

A modification in the suspension is shown in Figs. 2 to 5, inclusive, whereby current may be introduced to the pendulum coil, 7, without the employment of a coiled wire at the suspension. This device embodies a circular fibre plate, 23, to which is fastened, by a number of screws, 24, two steel knife-edge supports, 25 and 26. Resting upon these knife-edges, 25 and 26, is a rocking ring, made up of two segments, 27 and 28, secured together, but insulated from each other, by two fibre pieces, 29 and 30, screens, 31, together with a number of insulating bushings. Four V-shaped cuts, 32 to 35, inclusive, are made at 90° to each other in the segments, 27 and 28. The two supports, 25 and 26, rest in the cuts, 35 and 33, respectively, and are prevented from sliding therein by two steel stops, 36 and 37, held in position by a number of screws, 38. Resting in the other cuts, 32 and 34, and restricted from longitudinal motion therein by two stops, 39 and 40, are two steel knife-edges, 41 and 42, respectively. The stops, 39 and 40, are held in place, as are the other ones, numbered 36 and 37, by several screws, 38. The knife-edges, 41 and

42, are insulated upon a central rocking member, 43, by two pieces of fibre, 44 and 45, four screws, 46 and 49, inclusive, together with a number of insulating bushings. The twin concentric conductor, 6, which supports the pendulum spool, 9, is knotted in the central member, 43, and the wires of the said conductor, 6, are electrically connected, through the screws, 46 and 49, with the knife-edges, 41 and 42, respectively. It will thus be evident from the construction that current may be led to the pendulum coil, 7, by connecting the controlling circuit with the knife-edge supports, 25 and 26.

HIGH-POTENTIAL TYPE.

The present arrangement is designed to enable a Foucault pendulum organization to be frictionlessly and automatically maintained in vibration throughout its changing plane of oscillation. The accelerating coils of the system possess the same construction and dynamic action as those described in the preceding apparatus. The means, however, of introducing current to the pendulum and stationary coils at the moment that the former is just over the latter, takes advantage of the fact, that, when the secondary circuit of an

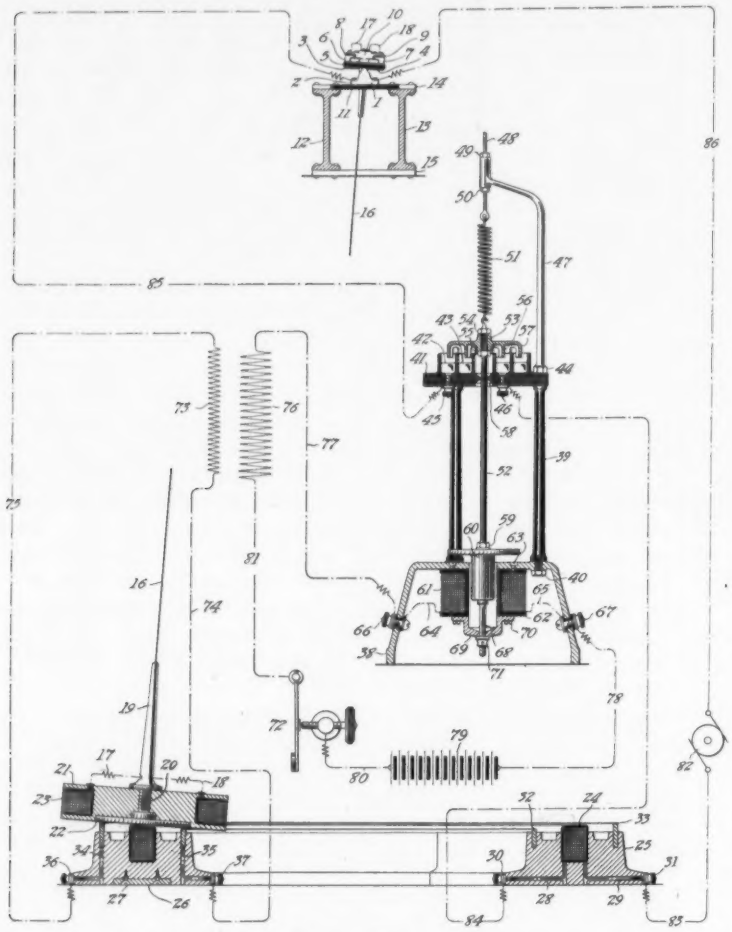


FIG. 2.—HIGH-POTENTIAL TYPE OF FOUCAULT PENDULUM.

induction coil is closed, the current in the primary is immediately augmented. If, now, the primary of the induction coil includes a make-and-break device, suitable battery and sensitive relay, the last of which independently commands the accelerating coils of the pendulum system and a source of current, and, furthermore, the secondary circuit of the induction coil is arranged to be closed by the pendulum with small air-gaps, when the said pendulum is terminating its swing over the stationary coil, the vibrating system will be constantly accelerated in whatever plane of oscillation it may be vibrating, for the temporary closing of the secondary circuit will immediately increase the strength of the primary current, which then instantaneously operates the relay, thereby sending current to the two pendulum coils and giving the system an acceleration. When the pendulum arrives at the other extremity of its amplitude, the same cycle of operations will again take place. The automatic principle of the system is capable of a number of modifications. In the illustration, a diagrammatic view of the organization is shown.

The pendulum system springs from an insulated knife-edge suspension, which, primarily made up of the members 1 to 10, inclusive, and detailed in the preceding description, is rigidly mounted upon a fibre plate, 11, riveted to two iron beams, 12 and 13. These beams, 12 and 13, which are secured together at each end by two metal plates, 14 and 15, may rest upon masonry supports when convenient. A twin concentric conductor, 16, is secured to the central portion, 10, of the suspension, and the two wires, 17 and 18, of the aforesaid conductor, 16, are electrically connected with the knife-edges, 6 and 7, respectively. The lower extremity of the twin conductor, 16, is fastened in a metal post, 19. This post, 19, has an extension, 20, which passes through a wooden spool, 21, and is threaded into a metal disc, 22, let into the under side of the aforesaid spool, 21. The lower ends of the two wires, 17 and 18, of the twin conductor, 16, are electrically joined with the terminals of a coil, 23, which is wound upon the pendulum spool, 21. The stationary accelerating coil, 24, is laid in a circular mounting, 25, which is constructed of wood and made in three sections, fastened together by a number of plates, 26 and screws, 27. The terminals, 28 and 29, of the stationary coil, 24, are, respectively, connected to two binding posts, 30 and 31, which are screwed into the mounting, 25. Incorporated in the mounting, 25, are two split copper rings, 32 and 33, which are employed, in connection with the pendulum disc, 22, for closing the secondary circuit of the induction coil. The rings, 32 and 33, are, respectively, joined by two wires, 34 and 35, with an equal number of binding posts, 36 and 37, secured to the mounting, 25. The reason for dividing the rings, 32 and 33, is so that currents will not be induced therein by the stationary coil, 24. The mounting, 25, is so adjusted with respect to the pendulum system that the center of the said mounting, 25, will be directly beneath the geometric point of suspension of the pendulum conductor, 16. The mounting, 25, is, furthermore, so arranged that it will have a minimum and constant clearance between its upper surface and the under side of the pendulum spool, 21.

The relay for controlling the accelerating circuit of the pendulum system consists of a brass base, 38, to the top of which three hard rubber columns, 39, are secured by an equal number of hexagonal nuts, 40. An ebonite receptacle, 41, having two annular mercury baths, 42 and 43, incorporated in the same, is fastened to the top of the columns, 39, by several hexagonal nuts, 44. Two binding posts, 45 and 46, secured to the receptacle, 41, electrically communicate with the mercury baths, 42 and 43, respectively. Threaded upon one of the columns, 39, is an extension, 47, which has an eye bolt, 48, adjustably secured therein by two hexagonal nuts, 49 and 50. Supported from the eye bolt, 48, by a retractile spring, 51, is a hard rubber rod, 52, having a contact member, 53, fastened thereto by two hexagonal nuts, 54 and 55. This contact member, 53, is provided with two annular projections, 56 and 57, which are adapted to short-circuit the mercury baths, 42 and 43. For enabling the contact to be a multiple one, the projections, 56 and 57, of the member, 53, are toothed. The binding posts, 45 and 46, are placed in series with the accelerating circuit of the pendulum. The rod, 52, is guided at the top by a circular knife-edge, 58, which is turned in the receptacle, 41. At the lower end the rod, 52, is locked by a hexagonal nut, 59, in an iron core, 60, which is adapted to be acted upon by a coil, 61. The spool, 62, upon which the coil, 61, is wound, is fastened to the base, 38, by two screws, 63. The terminals, 64 and 65, of the coil, 61, are, respectively, connected to two binding posts, 66 and 67, which are insulated upon the base, 38, and placed in series with the primary circuit of the already-mentioned induction coil. A spindle, 68, driven into the lower end of the core, 60, is guided by a circular knife-edge, 69, which is fastened to the under side of the spool, 62, by several screws, 70. A nut, 71, is threaded upon the spindle, 68, for limiting the upward motion of the core, 60, due to the retractile spring, 51. The retractile spring, 51, is so chosen and the eye bolt, 48, so adjusted, that the weight of the vertically-moving members will be taken up and the nut, 71, normally maintained against the under side of the knife-edge, 69. When, however, the current in the coil, 61, increases sufficiently to attract the core, 60, the toothed annular projections, 56 and 57, of the contact member, 53, will short-circuit the mercury contacts, 42 and 43.

The operation of the system, presupposing both that the pendulum has been started vibrating in the plane of the meridian, by burning a thread in the customary manner, and the vibrator, 72, of the induction coil, already referred to, has been set in motion, consists, when the pendulum spool, 21, is directly over the stationary coil, 24, of the passage of a number of sparks between the rings, 32 and 33, by way of the copper disc, 22. The secondary circuit of the induction coil is now closed. This circuit is composed of the secondary

winding, 73, wire 74, binding post 37, conductor 35, ring 32, disc 22, ring 33, wire 34, binding post 36 and conductor 75. Simultaneously with this flow of current through the secondary, the current in the primary circuit, which is made up of the primary winding, 76, wire 77, binding post 66, conductor 64, relay coil 61, wire 65, binding post 67, conductor 78, battery 79, wire 80, vibrator 72, and conductor 81, will be immediately increased and the relay coil, 61, energized sufficiently to attract its armature, 60. At this moment the projections, 56 and 57, of the contact member, 53, having been moved down into contact with the mercury baths, 42 and 43, a direct or alternating current from a dynamo, 82, is allowed to flow through the accelerating circuit, thereby producing a repulsion between the pendulum and stationary coils, 23 and 24, respectively, and accelerating the pendulum system. This accelerating circuit consists from the dynamo, 82, of a wire, 83, binding post 31, conductor 29, stationary coil 24, wire 28, binding post 30, conductor 84, binding post 46, mercury bath 43, annular projections 56 and 57 of contact member 53, mercury bath 42, binding post 45, wire 85, knife-edge support 2, segment 3 of rocking ring, knife-edge 6, conductor 17, pendulum coil 23, wire 18, knife-edge 7, segment 4, knife-edge support 1 and conductor 86. As soon as the pendulum coil, 23, has swung toward the center sufficiently for the secondary circuit to be broken, the current in the primary will drop to a minimum, and the contact member, 53, of the relay now being allowed to return to its normal position, the circuit of the accelerating coils, 23 and 24, will be interrupted. When the pendulum spool, 21, arrives at the other extremity of its vibration, the same action will again occur, thereby accelerating the pendulum system once more.

The high-potential principle above employed may possibly be further extended in conjunction with the laws of induction, in such a way that the pendulum will consist of a single steel wire. Such a pendulum system may embody a high-potential transformer, the primary of which, together with a large circular stationary accelerating winding, is in series with a source of alternating current. The secondary of the transformer is placed in series with a spark-gap device, which will allow the said secondary to be closed when the pendulum bob is over a portion of the stationary winding, the spark-gap arrangement being such as to render the primary and secondary circuits absolutely independent. The pendulum bob is provided with a short-circuited winding, and the stationary winding is so constructed that, when alternating currents flow in the same, similar alternating currents will be induced in the pendulum winding, when the said winding is directly over a portion of the stationary winding. The pendulum and stationary windings are furthermore so arranged that the directions of the induced currents in the pendulum winding will cause the pendulum to be accelerated toward the center. This method of connecting up the transformer is such that there will be little or no current in the primary coil and stationary winding, until the secondary is closed through the spark-gap device by the pendulum terminating its swing over the aforesaid stationary winding. When this takes place the current in the primary will instantaneously reach a maximum, thereby inducing repulsion currents in the pendulum winding, with a consequent acceleration of the vibrating system. When the secondary is broken the accelerating current will drop to a minimum again until the pendulum arrives at the other side of the stationary winding, at which time the same cycle of operations will be once more performed.

The method of inducing currents in the pendulum coil, with the advantage that a fine steel wire may support the bob of the vibrating pendulum system, may be perhaps arranged in such a way that the stationary winding will be of approximately the same dimensions as the pendulum winding, and located directly under the pendulum suspension. The wiring of the transformer is the same as above outlined, and the action of the spark-gap device, together with the inducing and induced currents, is so planned that a repulsion will occur between the pendulum and stationary windings after the vibrating system has passed the vertical.

SYNCHRONOUS TYPE.

A further method is herewith shown for automatically accelerating Foucault pendulums of any size, however their planes of oscillation may change, there being no material contact with their vibrating systems. The magnetic coils of the system are analogous in their construction and dynamic action to those employed in the preceding studies. The automatic means of operating the pendulum system, however, consists in providing a controlling contact mechanism, which, adjusted in synchronism with the Foucault pendulum, or the latter regulated with respect to the former, sends impulses of current to the pendulum and stationary coils of the organization, when the pendulum of the same is moving toward the center of the stationary coil. In this manner the Foucault pendulum is constantly accelerated. There is, furthermore, herein illustrated a magnetic starting device for the pendulum, thereby obviating the necessity of employing the customary arrangement, where a thread, which holds the pendulum at one of the extremities of its swing, is burned.

By reference to the drawings, Fig. 1, is a diagrammatic scheme of the pendulum system, Fig. 2, a front elevation of the mechanism for controlling the pendulum, and Fig. 3 a detail of the differential gear adjustment for the contact wheel.

The Foucault pendulum primarily embodies a suspension system, which consists of two iron beams, 1 and 2, metal plate 3, fibre base 4, posts 5 and 6, cone-shaped capstan screws, 7 and 8, insulated rocking ring, made up of the two portions 9 and 10, insulated capstan screws 11 and 12, bridge member 13, tube 14, hexagonal nut 15

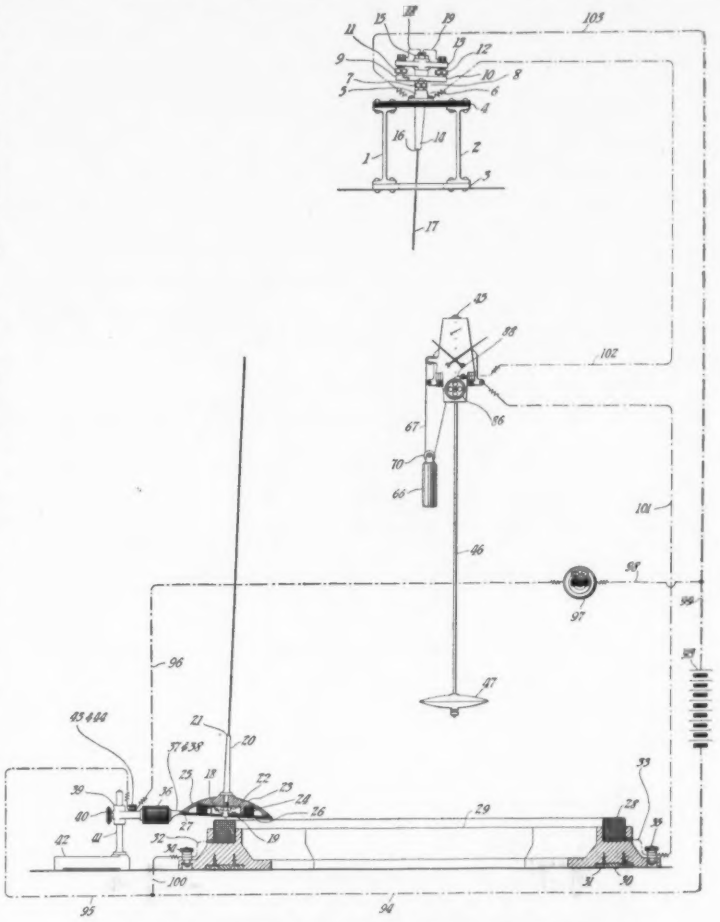


FIG. 3.—SYNCHRONOUS TYPE OF FOUCAULT PENDULUM.

and fibre lining 16. A small twin concentric pendulum conductor, 17, passes through the fibre lining, 16, of the suspension tube, 14, and is held in place by tying a knot in it. The wire, 18 and 19, of the twin conductor, 17, are connected with the insulated capstan screws, 11 and 12, respectively. The lower end of the conductor, 17, is fastened in a pendulum bob, which is made up of a metal post, 20, fibre lining 21, hexagonal nut 22, wooden spool 23, pendulum coil 24, iron rim 25, fibre disc 26 and a number of screws 27. The wires, 18 and 19, of the twin conductor, 17, are electrically joined with the terminals of the pendulum coil, 24. The iron ring, 25, the purpose of which will be described hereafter, is radially slotted in a number of places, in order that currents will not be induced therein by the periodic energization of the pendulum coil, 24. This is particularly necessary if alternating current is employed in the pendulum accelerating circuit. The shape of the pendulum bob is such as to displace as little air as possible in its vibration and changing plane of oscillation. This construction also enables the pendulum coil, 24, to swing directly over the stationary coil, 28. This coil, 28, is designed to be laid in a wooden mounting, 29, which, for the sake of convenience, is made in sections and fastened together by a number of plates, 30, and screws, 31. The terminals, 32 and 33, of the stationary coil, 28, are, respectively, connected to two posts, 34 and 35, which are secured to the mounting, 29. The device for starting the pen-

dulum vibrating consists of a magnet, 36, the poles, 37 and 38, of which are adapted to fit the circular iron ring, 25, of the pendulum bob. The cores of the magnet, 36, are provided with a yoke, 39, which is adjustably secured by a knurled screw, 40, upon a vertical rod, 41, driven into the corner of a heavy triangular base, 42. The terminals of the magnet, 36, are connected to two posts, 43 and 44, insulated upon the yoke, 39. By energizing the magnet, 36, which may be adjusted in any desired position, both vertically and horizontally, the pendulum may be held stationary, preparatory to setting it in vibration in the plane of the meridian. To start the pendulum all that is required is to interrupt the current in the magnet, 36.

The controlling contact mechanism, for providing periodic currents for accelerating the pendulum system, is shown in Fig. 1 and detailed in Figs. 2 and 3. This device consists of a second's pendulum movement, primarily embodying a cast-iron bracket, 45, pendulum 46, elliptical bob 47, frame plates 48 and 49, separating posts 50, together with the fastening members 51 and 52. Mounted between the frame plates 48 and 49 is an escapement train, having a ratio of 1:720, and made up of a barrel, 53, ratchets, 54 and 55, pawls 56 and 57, gears 58, 59 and 60, pinions 61, 62 and 63, thirty-toothed escapement wheel 64, and anchor 65. The barrel, 53, is operated by a weight, 66, through the medium of a cord, 67, which is wound about the aforesaid barrel, 53, and secured to a post, 68, driven into the front frame plate, 49. A pulley, 69, journaled upon the frame plate, 49, guides the cord, 67, from the barrel, 53, to a second pulley, 70, mounted upon the weight, 66. With an ordinary drop for the weight, 66, the ratios are such as to drive the pendulum, 46, for eight days. A second gear train, having a ratio of 1:720, is also driven by the barrel, 53, the members of the said train being numbered 71 to 75, inclusive. The terminating spindle, 76, of this

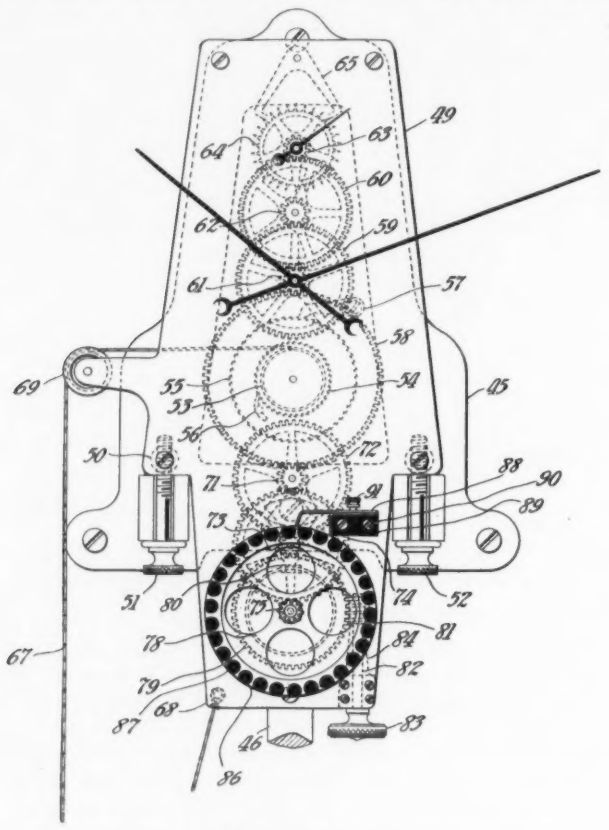


FIG. 4.—CONTACT MECHANISM OF SYNCHRONOUS TYPE.

second train has mounted thereon a differential gear adjustment, which consists of two crown gears, 77 and 78, intermediate worm gear 79, plantetary pinion 80, worm 81, spindle 82, knurled adjustment member 83, and journaling portion 84. The crown gear, 78, is secured to a sleeve, 85, which, mounted loosely upon the spindle, 76, passes through the frame plate, 49, and has secured thereto a contact wheel, 86, having a number of fibre rods, 87, let into its periphery. The circumference of the contact wheel, 86, is turned down sufficiently to make the insulating and metallic spaces equal in width. Bearing upon the contact wheel, 86, which, on account of the gearing, makes one turn per minute in an anti-clockwise direction from the front, is a platinum-pointed spring, 88, mounted upon the frame plate, 49, by a fibre block, 89, together with several screws, 90 and 91. From the property of the differential adjustment, when the worm, 81, is revolved by turning the knurled member, 83, the contact wheel, 86, may be adjusted, while running, until the impulses of current, which are sent to the pendulum accelerating coils, 24 and 28, are in proper step with the vibrations of the Foucault pendulum system. When desired a dial, 92, may be mounted upon the frame plate, 49, of the movement, an opening being provided in the said dial, 92, for the contact spring, 88, to pass therethrough.

For enabling the mechanism to control pendulums of different lengths, it is intended that a number of contact wheels, similar to that numbered 86, but having varying numbers of insulated rods driven into their peripheries, shall be employed. Thus, if the Foucault pendulum makes one beat per second, the electrical contact, while the pendulum coil, 24, is traveling toward the center of the

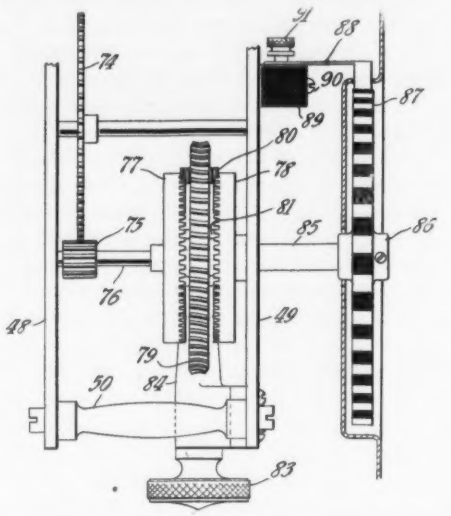


FIG. 5.—CONTACT ADJUSTMENT OF SYNCHRONOUS TYPE.

stationary coil, 28, should last .5 second, and there will be sixty contacts, together with an equal number of insulating spaces upon the periphery of the contact wheel. For a pendulum having a beat of 1.5 seconds, the contact should last .75 second, and there will be forty fibre rods in the contact wheel. If the pendulum makes a vibration in two seconds, the electrical contact will have a duration of one second, and there will be thirty fibre rods in the contact wheel. With a beat of 2.5 seconds for the pendulum, the contact will last 1.25 second, and there will be twenty-four fibre rods in the contact wheel. For a pendulum making as oscillation in 5 seconds, the contact will last 2.5 seconds, and the contact wheel should have twelve fibre segments. With a pendulum making a vibration in 7.5 seconds, the contact should last 3.75 seconds, and there will be eight insulating rods in the periphery of the contact wheel. By being able to substitute different contact wheels, the controlling mechanism may be adapted to a Foucault pendulum of any given length.

Having set up the pendulum system in an enclosure, if possible similar to the dome of the Pantheon in Paris or other like structure, the pendulum bob is held at one of the extremities of its amplitude by energizing the magnet, 36, of the starting device, the circuit consisting from a battery, 93, or other suitable source of current, of two conductors, 94 and 95, binding post, 43, coils of magnet, 36, post 44, wire 96, switch 97, together with the conductors 98 and 99. When it is desired to start the Foucault pendulum, the switch, 97, is opened, and, the magnet, 36, being now without attractive force, the pendulum will begin to vibrate. The knurled member, 83, of the controlling mechanism is then adjusted until the impulses of current, sent out therefrom to the pendulum coils, 24 and 28, always occur while the pendulum is traveling toward the center of the large coil, 28. The circuit for producing this constant acceleration embodies the battery, 93, conductors, 94 and 100, post 34, wire 32, stationary coil 28, conductor 33, post 35, wire 101, frame 45 of controlling movement, contact wheel 86, spring 88, conductor 102, post 5, capstan screw 7, portion 10 of rocking ring, capstan screw 12, wire 19 of pendulum twin conductor 17, coil 24, wire 18, capstan screw 11, portion 9 of rocking ring, capstan screw 8, post 6, together with the conductors 103 and 99. In setting up the system, the length of the Foucault and current-controlling pendulums, together with the contact wheel, should be so chosen and adjusted that the occurrences

of the accelerating current will be in synchronism with the oscillations of the aforesaid Foucault pendulum. The general principle of the organization is also applicable to time service systems.

In the above series of electrically-operated Foucault pendulums, current has been simultaneously sent through the pendulum accelerating coils in the same direction, thereby causing the pendulum coil to be accelerated toward the center of the stationary coil. It is believed that the reverse action may be also employed for operating Foucault pendulums. In this case, current is allowed to flow at the same instant in opposite directions in the two accelerating coils, the pendulum being radially accelerated away from the center of the stationary coil.

For measuring the angular change of the plane of oscillation of Foucault pendulums, other devices may be employed, irrespective of the customary method where a fine needle, which is affixed to the bottom of the pendulum bob, is allowed to travel over a graduated circle or make small furrows through the top of a pointed heap of sand. When the length of the pendulum is suitable, and the facilities are favorable therefor, the angular variation may be observed from a point just below the suspension. The arrangement for this purpose may consist of a graduated ring, which is rotatively secured to a suitable horizontal mounting, the pendulum occupying the center of the aforesaid ring. A fine wire is attached to opposite points of the ring, and passes within a short distance of the pendulum. An index is provided upon the mounting adjacent to the graduations upon the ring. Having turned the ring until the wire is coincident with the plane of oscillation of the pendulum bob below, the angular change may be observed, at the end of any given period of measurement, by again revolving the ring until the wire is in coincidence with the pendulum's path. This operation may be facilitated by suitably mounting a telescope upon the graduated ring, and providing a highly polished point in the center of the pendulum bob to sight upon. Another method may embody a carriage which is adapted to slide around a graduated ring, mounted symmetrically at the bottom of the pendulum system. Passing radially through the carriage is a pointed rod, which may be moved up to the pendulum wire, when the same is resting in its normal vertical position or at the end of its maximum amplitude. Having once set the rod in the plane of vibration of the pendulum, the angular change may be noted at any time by circumferentially moving the carriage until the rod is again in coincidence with the pendulum's plane. When desired, the mounting of the stationary accelerating winding of the pendulum system may be arranged to receive the above-mentioned sliding carriage.

The Theoretical Determination of Power Curves.

By William J. Berry.

THE close relation existing between practical electrical engineering and the higher mathematics is daily receiving wider and wider recognition from engineers of established reputation, while the fact that many mathematical theorems find their best illustrations in electrical phenomena is well known to all who have pursued mathematical investigations to any considerable extent. The time has passed when the practical rule-of-thumb electrician could afford to sneer at the mathematical engineer, because of the latter's theorizing; empiricism has carried the profession as far as it can, henceforth the advance must be along the strictest scientific and theoretic lines. Many facts, revealed by experimental investigation, and made familiar through long-continued practice, are demonstrable from the standpoint of the mathematician.

One such subject is that of power curves. Every alternating-current engineer knows that with an impressed harmonic e.m.f. of sine-wave shape, the resultant power curve is a sine curve of double frequency, but so far as the present writer knows there exists no rigid mathematical demonstration of this fact. Messrs. Ryan, Norris and Hoxie, in their recently-published book, have proved it for certain special values of the angle of lag, but the demonstration which follows is valid for any amount of phase difference, whether the current leads or lags behind the e.m.f.

Let the curve, E, in Fig. 1, represent a pressure curve of sine-wave shape, and suppose its equation to be $y = A \sin x$, where A is a constant; let I, in the same figure, be the current curve, differing in phase from E by the angle ϕ, and let $y' = B \sin [x \pm \phi]$ represent its equation, in which B is a constant, and the plus or minus sign is to be used, according as ϕ is the amount of lag or lead of the current. Since the instantaneous power is equal to the product of the instantaneous pressure by the instantaneous current, the ordinates of the power curve, P, must be the product of the corresponding ordinates of E and I, and the equation of P is $y'' = y\,y' = A\,B \sin x \sin [x \pm \phi]$.

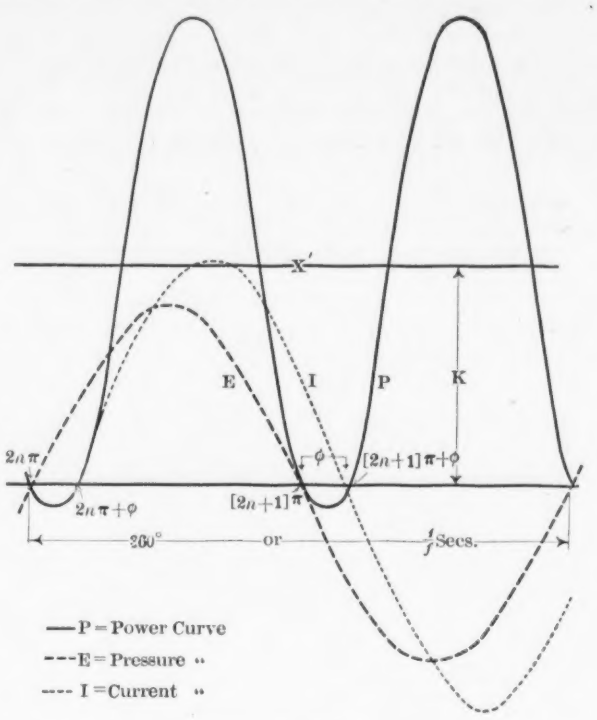


FIG. I.—PRESSURE CURVE.

Expanding this expression, and replacing $A\,B$ by C,

$$y'' = C\,[\sin^2 x \cos\phi \pm \sin x \cos x \cos\phi].$$

Now, in any given case ϕ, and, therefore, $\sin\phi$ and $\cos\phi$ are constant throughout, hence

$$y'' = C\,[a \sin^2 x \pm \beta \sin x \cos x],$$

where

$$a = \cos\phi \text{ and } \beta = \sin\phi.$$

This may be further simplified,

$$y'' = a' \sin^2 x \pm \beta' \sin x \cos x,$$

where

$$a' = C\,a, \text{ and } \beta' = C\,\beta.$$

$$y'' = a' \sin^2 x \pm \frac{\beta'}{2} 2 \sin x \cos x,$$

$$y'' = a' \sin^2 x \pm \frac{\beta'}{2} \sin 2x.$$

Differentiating with respect to x,

$$D_x\, y'' = 2a' \sin x \cos x\, dx \pm \frac{\beta'}{2} \cos 2x \,.\, 2\,dx,$$

$$D_x\, y'' = \frac{a'}{2} \sin 2x \,.\, 2\,dx \pm \frac{\beta'}{2} \cos 2x \,.\, 2\,dx.$$

Integrating,

$$y'' = -\frac{a'}{2} \cos 2x \pm \frac{\beta'}{2} \sin 2x + K,$$

where K is the constant of integration. If, now, we replace $\frac{a'}{2}$ by $C' \cos\phi$, and $\frac{\beta'}{2}$ by $C' \sin\phi$, where $C' = -\frac{C}{2}$, the equation reduces to

$$y'' = C' [\cos 2x \cos\phi \mp \sin 2x \sin\phi] + K.$$

To eliminate the constant, K, we may transform the equation to a parallel X-axis, such that y''', the new ordinate of P, is equal to $y'' - K$, whence

$$y''' = C' \left[\cos' 2x \cos\phi \mp \sin 2x \sin\phi \right].$$

The significance of this transformation of co-ordinates will be explained later. But

$$y''' = \frac{C'}{2} \left[2 \cos 2x \cos\phi \right] \pm \frac{C'}{2} \left[-2 \sin 2x \sin\phi \right].$$

$$2 \cos 2x \cos\phi = \cos \left[2x + \phi \right] + \cos \left[2x - \phi \right],$$

and

$$-2 \sin 2x \sin\phi = \cos \left[2x + \phi \right] - \cos \left[2x - \phi \right].$$

(See Wentworth's Trig., § 31, or Murray's Trig., § 52.)
Hence,

$$y''' = C' \cos \left[2x \pm \phi \right] = C' \sin \left[\frac{\pi}{2} - (2x \pm \phi) \right],$$

which proves that under the given conditions, the power curve is a sine curve.

Now, the number of lobes of the curve per cycle is equal to the number of roots per cycle; that is, to the number of times the curve cuts the X-axis. The pressure curve, E, or $y = A \sin x$, has roots, that is, $y = 0$, whenever $\sin x = 0$, since by hypothesis A cannot be zero; but $\sin x = 0$ for $x = 2n\pi$, or $[2n + 1]\pi$; that is, twice in one cycle, or twice during the interval $1/f$ secs., where f is the number of cycles per second.

Similarly, $y' = B \sin [x \pm \phi]$, the current curve, has roots whenever $[x \pm \phi] = 2n\pi$, or $[2n + 1]\pi$, and this occurs twice during the interval $1/f$ seconds.

But the power curve, P, being of the form $AB \sin x \sin [x \pm \phi]$, will have roots whenever either $\sin x = 0$, or $\sin [x \pm \phi] = 0$. P, therefore, cuts the X-axis at $x = 2n\pi$, $x = [2n + 1]\pi$, $x = \mp \phi 2n\pi$, $x = [2n + 1]\pi \mp \phi$, or four times during the interval $1/f$ seconds; which shows that the power curve has double the frequency of either the e.m.f. or current curves, and that this is totally independent of phase difference.

By referring to Fig. 1, it will be noticed that X, the axis of symmetry of E and I, is not the axis of symmetry for P, but that X', parallel to X, is such an axis. When in the foregoing discussion we transformed the equation from one set of co-ordinates to another

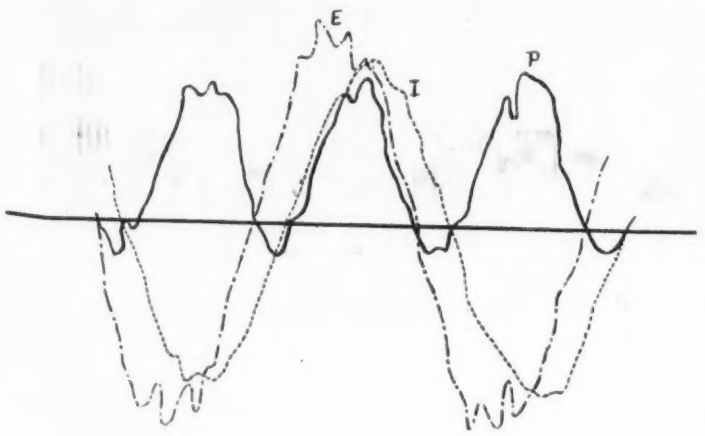


FIG. 2.—CURVES.

in such manner as to eliminate the constant, K, we were really transferring from X to X', the constant of integration, K representing the distance between X and X'.

In Fig. 2 is given a set of curves obtained by the writer and his associates, from a ½-kw Westinghouse alternator in the laboratory of the Polytechnic Institute of Brooklyn, the alternator carrying an inductive load. Though only approximating the sine shape, this power curve illustrates the main points discussed in this article. The ordinates of the power curve in Fig. 2 have been multiplied by a reduction factor, to bring the curve within the limits of the cross-section paper employed in the original, of which this figure is a tracing.

Sports in Aid of Spanish War Veterans.

The Spanish War Veterans' organization, which is about to conduct athletic sports in this city, is composed of veterans of the Spanish war who were honorably discharged or mustered out. The association is similar to and modeled upon the Grand Army of the Republic. Many comrades are at times in needy circumstances and require financial assistance. The widows and children of deceased comrades frequently require help and funds are needed to defray the burial expenses of comrades who die in poverty. These are worthy charities which appeal to all who honor these men who fought for their country in the Spanish war. The treasuries of the corps and individual commands, replenished only by per capita taxes, are insufficient. Funds disbursed by the Spanish War Veterans' Associations for such purposes are disbursed under scrupulous supervision and only in the most worthy cases.

General Eugene Griffin is corps commander of the State of New York Spanish War Veterans, which comprises about thirty-five commands and nearly 5,000 enrolled comrades. The commands in the vicinity of New York City (about twenty) have arranged to hold a military athletic tournament in the armory of the Twenty-second Regiment, N. G. S. N. Y., on March 5, 1904, the net proceeds to go to the treasuries of the corps and commands concerned. In order that the tournament may be held under the auspices and with the sanction of the Amateur Athletic Union, it has been necessary for the commands to organize the Spanish War Veterans' Athletic Association, and the tournament will be held in the name of such association.

Great interest has been manifested in the project. The use of the armory has been donated, and the services of all concerned in the tournament (other than the professionals, such as starter, handicapper, etc.) have been and will be given free. The tournament will be the athletic event of the winter.

The prizes will have sentimental as well as intrinsic value. President Roosevelt has donated funds for the purchase of a prize. Admiral Dewey has donated a cup with a personal letter, suggesting that the cup be offered as the "Dewey Cup." Cups have also been donated by Hon. Elihu Root, Secretary of War; Gen. Robert Shaw Oliver, Assistant Secretary of War; Gen. Geo. L. Gillespie, Chief of Engineers; Gen. Wm. Crozier, Chief of Ordnance; Col. John Jacob Astor, Senator Depew, Senator Platt, Senator Proctor, Senator Hanna, Senator Alger, Senator Lodge, Hon. Geo. B. McClellan, Hon. Wm. Randolph Hearst.

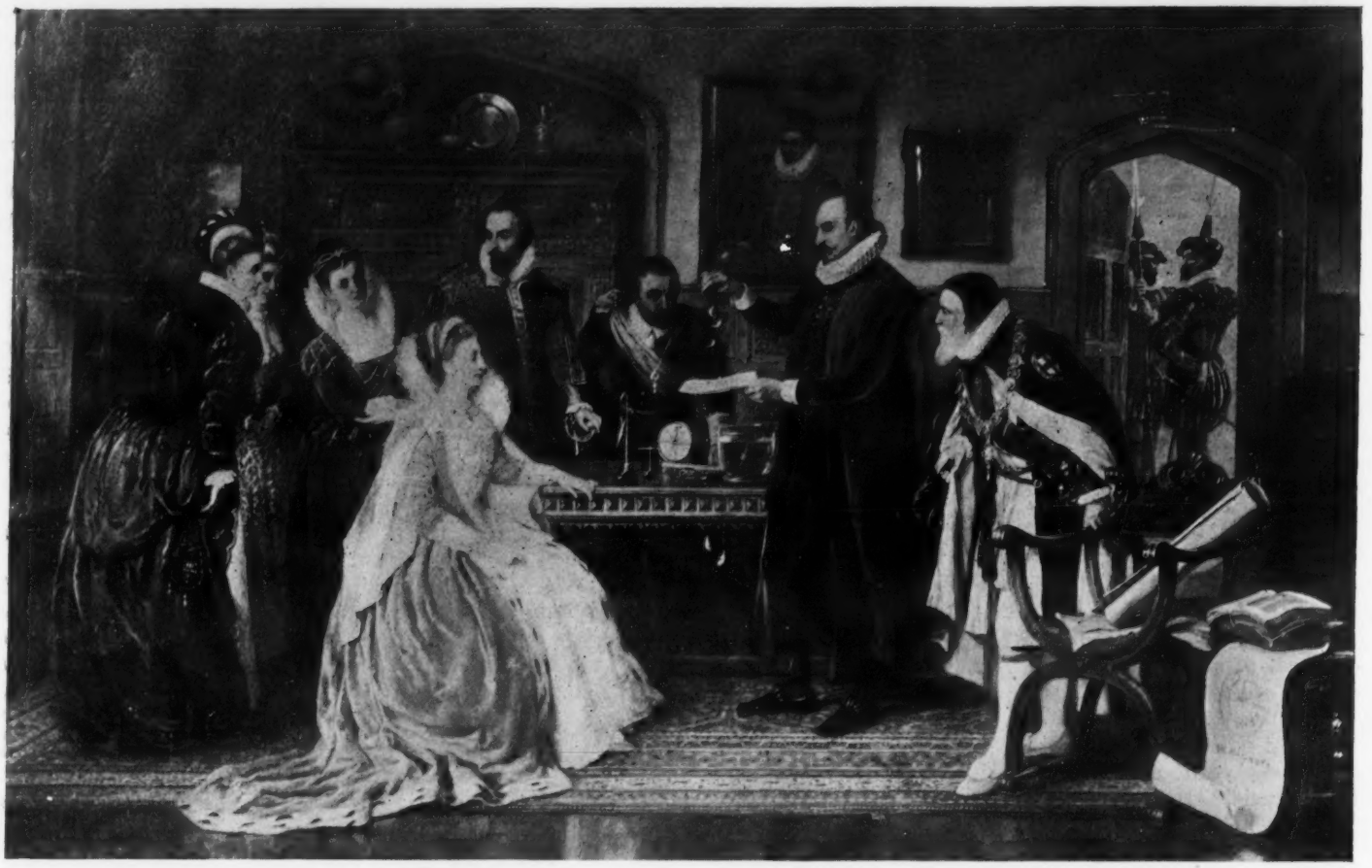
It is expected that other prizes will be offered by prominent officials of the Army and Navy, by Senators and Representatives of the United States Congress and by governors of States. The interest in the tournament, the number of athletic entries and the attendance will be greatly increased by the desire to win cups presented by such donors. Subscriptions from those interested should be paid to Gen. Eugene Griffin, at 44 Broad Street, New York City, for the prize fund of the tournament to be held for the benefit of the Spanish war veterans, as above described.

Philadelphia A. I. E. E. Meeting.

The regular meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held January 11 at the Engineers' Club. Mr. W. C. L. Eglin discussed the paper presented by Mr. George H. Lukes at the New York meeting on "Overhead High-Tension Distributing Systems in Suburban Districts." He also presented his own paper on "Safeguards and Regulations in Operation of Overhead Distributing System," with considerable amplification. Mr. J. T. Hutchings, of the Philadelphia Electric Company, presented a paper, using Mr. E. J. Bechtel's paper on "Automatic Apparatus for Regulating Generator and Feeder Potentials" as a basis, and going somewhat further into the matter than Mr. Bechtel did. Mr. J. B. Klumpp, of the United Gas Improvement Company, of Philadelphia, presented a paper, discussing and criticising the paper on "Gas Power for Central Stations," read by Mr. J. R. Bibbins at New York. The discussion of these papers was participated in by Messrs. Paul Spencer, W. C. L. Eglin, C. W. Pike, Charles Hewitt, H. A. Foster, J. B. Klumpp and Carl Hering.

The Gilbert Tercentenary Picture.

Some details were recently given in these pages of the presentation of a picture to the corporation of Colchester, England, by the Institution of Electrical Engineers, to celebrate the three-hundredth anniversary of the death of Dr. Gilbert, December 10. We are now glad to be able to publish herewith a reproduction of the historical painting in question. The artist is Mr. A. Ackland Hunt, and the original picture measures about 6 ft. x 4 ft. Its cost was defrayed by private subscription and the picture, it appears, was exhibited originally at the Manchester Exhibition in 1876. Prof. Silvanus P. Thompson and Mr. Conrad W. Cooke acted as honorary secretaries of the fund and the contributions were given by past and present members of the council of the Institution. As will be seen, it is an interesting and vigorous piece of work, and it is considered by students of the period, such as Prof. Thompson, a faithful piece of portraiture as well as a happy piece of imagination as to just what might have occurred when Gilbert made an exhibition before Queen Elizabeth of some of his experiments and investigations.



THE ACKLAND HUNT PICTURE OF DR. GILBERT MAKING EXPERIMENTS BEFORE QUEEN ELIZABETH.

Gilbert was born in the town in which he died and spent the best part of his life there, aside from the time given to the practice of his profession in London. It may be noted that Gilbert was born at Colchester on May 25, 1544, in a house which is still standing, and to which he returned in his later years. It may be added that Dr. Gilbert, as physician to Queen Elizabeth and president of the Royal College of Physicians, was one who would naturally stand high in her favor and whose demonstrations as thus depicted would be witnessed by the Virgin Queen with unusual interest.

There are not many historical pictures on electrical subjects and this makes a worthy addition to that which is doubtless well known to our readers, of Volta explaining his voltaic pile to young Napoleon, and the other one, perhaps better known in this country than abroad, of the gathering of the pioneers of the first Atlantic cable, now hanging in the New York Chamber of Commerce. Some day, perhaps, in the new Union Engineering Building, the American Institute of Electrical Engineers may become the recipient of other works of this character from generous friends and members. To-day the Institute is even without a picture or a bust of Franklin.

Electrification of an English Steam Railway.

The Lancashire & Yorkshire Railway Company, one of the most important of the shorter steam railroads in England, has substituted electricity for steam as motive power, and the electrical operation of a portion of the line was recently inaugurated. The 600-volt direct-current rotary-converter system is used, with alternating-current transmission to the converter sub-stations at 7,500 volts. The line is 23 miles long and double-tracked.

The trains generally are composed of two first and two third-class cars, the third-class cars of which are equipped with four motors of 150 hp each, making a total of 1,200 hp per train. To operate these motors current is obtained from a third rail, which is fed with direct current at about 600 volts from four sub-stations, three of which are situated at Birkdale, Seaforth and Sandhills, respectively, and another in the main power house building at Formby.

The power station adjoins the railway, on the banks of the River Alt, at Formby, and is a building 290 feet long by 130 feet wide, consisting of an independent steel structure, the steel stanchions of which, in addition to carrying the roof, support traveling cranes over the engine room, the spaces between the stanchions being filled with brickwork. It has two spans, one containing sixteen Lancashire boilers, 8 feet 6 inches in diameter, by 32 feet long, for a working pressure of 160 pounds per square inch, together with superheaters, feed pumps, induced draught plant, etc.; the other and larger span contains four horizontal cross-compound condensing engines of 1,500-kw capacity, also one subsidiary vertical compound condensing engine of 750-kw capacity, capable of taking large overload for short periods.

The generators in connection with these engines are of the three-phase type, with a periodicity of 25, and a voltage of 7,500. The engine room also contains steam-driven exciters, sub-station plant and a main switchboard.

Three-core paper-insulated metallic-sheathed cables convey the high-tension current to the sub-stations, and are laid on what is known as the "solid system," at a suitable depth along the company's right of way.

The sub-station equipments, similar in character, consist of trans-

formers, which step-down the three-phase alternating current of 7,500 volts to low-tension alternating current, from which it is converted in rotary converters to direct current at 600 volts. The rotary converters are nominally of 600-kw capacity, four being provided in each sub-station, and three static transformers, cooled by means of air blast, are provided in connection with each rotary. The connections from these sub-stations to the third rail are made by insulated copper cables, run underground in troughing.

The third rail is carried outside the track rails, and is supported

FIG. I.—MAP OF ROUTE.

at intervals of 10 feet on insulators. The center of the rail is 3 feet 11½ inches from the center line of the track, and the top of the rail 3 inches above the surface of the track rails, these being limensions agreed upon between all the British railway companies.

The third rail, which is of special composition to secure conductivity, weighs 70 pounds per yard, and is protected by a timber guard rail at points where there might be danger of accidental contact. To insure a good return circuit a fourth rail, supported on wooden blocks, has been placed in the 4-foot way, and bonded to each running rail; this method of return, it was thought, would interfere least with the running tracks, and would permit the easy removal of any running rail at any time.

The cars differ from those used on the steam lines of the company, and were built especially for the service. They are 60 feet long and 10 feet wide, being the widest cars in Great Britain. This width was adopted because it was found before any operations were begun that it was possible on the Southport line, as distinguished from other parts of the main line, to have wider stock, some slight alterations to the track and some trifling ones to the platforms along this length alone being necessary. The carriages have center aisles throughout, with vestibules to allow passage from one carriage to the next, this arrangement being borrowed from American practice.

The motor cars are at the ends of the train, and are the third-class cars, and, as previously described, are equipped with two 150-hp motors on each truck, and with multiple-unit control. The front end has a small compartment for the motorman, containing all the apparatus for controlling the train; and near this is a baggage compartment, the remainder of the car being devoted to passengers. Most of the seats are cross-seats, and seat three on one side of the passage and two on the other, but at the ends are longitudinal, to allow more room for passengers entering or leaving the cars. The trailers or first-class cars have seats arranged after the same design, but only two on each side of the passage. A four-car train will carry 270 passengers, the third class seating 69 and the first-class 66 people. The delay at stations will be reduced to the smallest possible amount. Notice boards are hung on the platforms showing passengers where to stand to await their class, and in order to ensure quick loading and unloading of passengers, strict regulations are made that every passenger is to enter the cars at the end door and leave by the front door, thus ensuring a continuous circulation.

In view of the alarm caused within recent months by fires on electric trains, the company has taken all possible precaution against such an occurrence. The motor compartments have, with the exception of the roof, which is covered with sheet-steel plates, been lined with uralite, a well-known fireproof material, the floor also being fireproof. In addition, the cable conduits are lined with uralite, and the whole of the floor over the motors is covered with the same material and thin steel plates. All the trains also carry fire appliances.

The vacuum brake used on the trains is, with some slight differences, the same as that used all over the Lancashire & Yorkshire Railway. It is fitted with quick-acting valves, but is provided with an electrical exhauster in place of the steam ejector on the locomotive.

The service will start with a 10 minutes headway in both directions between Liverpool and Hall Road, and every second train will run through to Southport. In addition an hourly express will run in each direction between Liverpool and Southport, and at certain times the trains arriving at Southport from Liverpool will go on to Crossens. The accommodation trains between Liverpool and Hall Road and those between Liverpool and Southport will be run in less time than at present, but it is not intended that the expresses to Southport shall do the journey in less time than the fastest steam trains now running.

The whole of the work with the exception of the rolling stock, which is being made at the Horwich and Newton Heath Works of the railway company, is being carried out by Dick, Kerr & Company, Ltd., of London and Preston, who are now completing at their Preston works the main and auxiliary generators, the sub-station equipment, the control equipments of the trains and the rest of the electrical plant.

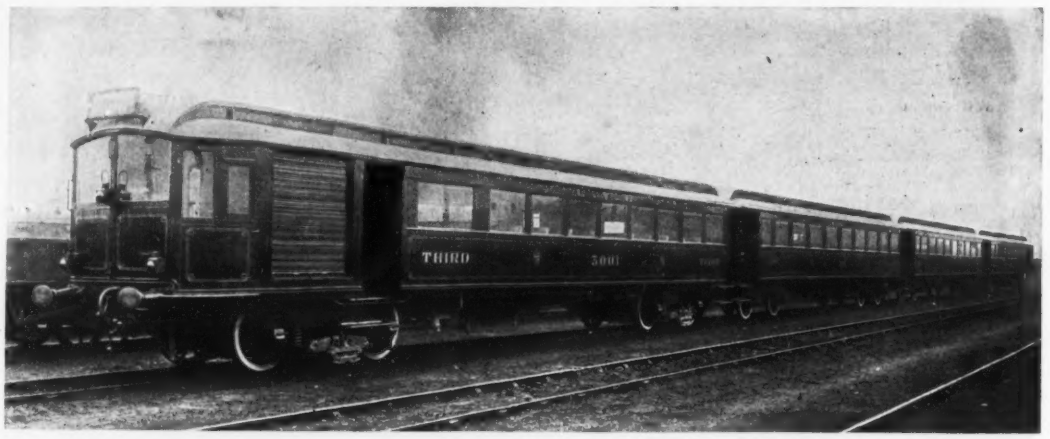


FIG. 2.—ELECTRIC TRAIN ON LANCASHIRE & YORKSHIRE RAILWAY.

Automobile School.

The Boston Y. M. C. A. inaugurated an automobile school last fall. The course embraces practical as well as theoretical study and instruction as to automobiles. This is claimed to be the first automobile school established in the world, and, according to a recent report, it has been very successful so far.

International Electrical Congress of St. Louis.

According to the present indications, the International Electrical Congress, to be in session at St. Louis, September 12-17, 1904, will be one of the most successful that has yet been held, both with respect to the number of adhesions and to the value of the transactions.

Up to date about 3,550 circular letters of invitations to join the Congress have been issued to persons or associations in North America. From these 875 postcard acceptances of membership have been received. About 350 similar circular letters of invitation have been recently sent to other countries. It is intended to issue in all about 5,000 invitation circular letters in America and about 6,000 in foreign countries. It is expected that many persons will join the Congress, both in America and abroad, who do not expect to attend the sessions in St. Louis, in order to secure a copy of the Transactions, which will form one and perhaps two large octavo volumes. Collection of fees has commenced, and upon receipt of a fee the member will be forwarded a certificate of membership. The certificate is 8½ in. by 11 in. in size (21.5 cm. x 28 cm.) and printed on heavy paper of excellent quality. A miniature replica of this certificate, without the signatures, is appended.

Recently 280 special letters of invitation have been issued on behalf of the committee of organization to prominent electricians and electrical engineers, signed by the president and the general secretary of the committee, requesting papers for the Congress in the various sections. Of these 146 have been sent to foreign authors, and 134 to American authors. There has not been time to receive replies from more than a few foreign authors, but 21 acceptances have, up to date, been received from abroad, and 46 acceptances from North America. Sixty-seven papers are thus already promised for the Congress, and the number is steadily increasing. A considerable number of invitations to contribute papers have yet to be issued. It is hoped that the Congress will convene with a full programme in each section, and that at least half of the papers may be from foreign countries. According to the plans of the committee, papers for the Congress programme are specially invited, but papers voluntarily offered will be submitted to the officers of the sections to which the papers belong, and may be included in the programme by invitation at their request, if the subjects are desirable, and if the schedule allotted to each section will permit, it being the desire of the section officers to secure and offer the best possible programme and presentation.

Petitions from the Congress Committee of Organization, and from the president of the American Institute of Electrical Engineers, have been filed with the Department of State at Washington, through the Department of Commerce and Labor, and the National Bureau of Standards, urging that the various foreign governments should be invited to appoint official delegates to the Congress. The lists of such delegates to be invited is, in accordance with the lists, allotted to the various countries at the Paris Congress of 1900, and the Chicago Congress of 1893. Including the United States, the lists comprise 56 official delegates. Information has been received that these petitions have been granted, and that the State Department on the 17th of December, 1903, instructed the diplomatic officers of the United States abroad to extend an invitation to foreign countries to be represented at the Congress by delegates.

Arrangements are being made with a view to perfecting plans of co-operation between the Congress and electrical societies and associations in various parts of the world. Invitations have already been extended to the Congress members to visit places of electrical interest on the journey to or from St. Louis.

The Committee of Organization of the Congress consists of Elihu Thomson, president; A. E. Kennelly, general secretary; W. D. Weaver, treasurer; Bion J. Arnold, vice-president and chairman of Executive Committee; C. F. Scott, Dr. S. W. Stratton, Prof. H. S. Carhart and Prof. W. E. Goldsborough, vice-presidents.

The following section officers (chairmen and secretaries) have been appointed by the president, and have already done much work in organizing their sections:

Sec. A General Theory,	Prof. E. L. Nichols, Cornell University.	Prof. H. T. Barnes, McGill University.
Sec. B General Applications,	C. P. Steinmetz, Schenectady.	Prof. Samuel Sheldon, Brooklyn.
Sec. C Electrochemistry,	Prof. H. S. Carhart, Univ. of Michigan.	Carl Hering, Philadelphia.
Sec. D Elec. Power Transmission,	Mr. C. F. Scott, Pittsburg.	Dr. Louis Bell, Boston.
Sec. E Electric Light and Distribution,	Mr. J. W. Lieb, Jr., New York.	Mr. G. S. Dunn, New York.
Sec. F Electric Transportation,	Dr. Louis Duncan, Mass. Inst. of Technology.	Mr. A. H. Armstrong, Schenectady.
Sec. G Electric Communication,	Mr. F. W. Jones, New York.	Mr. Bancroft Gherardi, N. Y.
Sec. H Electrotherapeutics,	Dr. W. J. Morton, New York.	Mr. W. J. Jenks, New York.

All communications should be addressed to the General Secretary, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass. He reports general and widespread interest in the subject as indicated by the correspondence, the bulk of which may be faintly inferred from the figures that have been quoted above. Indeed, the interest attaching to the work of the Congress is one of the best of auguries as to its abounding success.

International Electrical Congress
ST. LOUIS
1904
Henry J. Caldwell
having been invited to participate in the
International Electrical Congress of St. Louis, 1904,
and having duly paid the fees is hereby enrolled a member with
the privilege of attending all general and sectional meetings,
and of receiving the printed transactions of the Congress.
For Committee of Organization
President
Treasurer
General Secretary

ELECTRICAL CONGRESS MEMBERSHIP CERTIFICATE.

An Automobile Engineers' Society.

Automobile engineers held a meeting last week in the club rooms of the New York Automobile Trade Club and organized the Society of Automobile Engineers, with E. T. Birdsall, of the Standard Automobile Company, in the chair. Those present favored the formation of a body similar to the American Society of Mechanical Engineers in objects and work. The chief mission of the society will be the interchange of technical automobile knowledge among the members. Quarterly meetings will be held and papers will be read on mechanical topics.

These officers were elected: President, A. L. Riker, Locomobile Company of America; first vice-president, Henry Ford, Ford Motor Car Company; second vice-president, John Wilkinson, Franklin Motor Car Company; secretary and treasurer, E. T. Birdsall, Standard Automobile Company. Membership Committee—A. H. Whiting, Edison Battery Company (chairman); A. L. Riker, L. I. Gibbs and E. T. Birdsall.

Nearly fifty applications for membership are in hand. There will be two classes of members, viz., an active class, for registered engineers, and an associate class, for members interested in automobile sale or construction who are not engineers. It is interesting to note the prominence of men of electrical training and connections.

Convention of the Northwestern Electrical Association.

IN our issue of last week a telegraphic report was given of the opening sessions of the convention of the Northwestern Electrical Association. Below we present a fuller account of the proceedings up to the time of adjournment.

Secretary-Treasurer Mercein's report called attention to the resolution adopted last January to hold a summer meeting at St. Louis, in the present year, in connection with the National Electric Light Association. He recommended that the association take action in regard to this. The balance in the treasury, as further reported, showed the finances of the association to be in good condition. Adjournment was then taken until 1.45 the same afternoon.

In the presidential address, Mr. F. W. Bowen called attention to the "Question Box" and "Wrinkle" department, which he had hoped to make a feature of the present convention, but had been prevented from so doing because of much additional work which had been thrown upon him incident to the destruction of his station by fire twice. The programme, however, was prepared with a view to presenting matters which would be of interest to the members, both active and associate. The question of pre-arranged discussion of papers was not considered advisable, as it would not afford the opportunity which otherwise would present itself, and because the ranks of the association include such men and minds as are competent enough to discuss any paper offered in the programme.

Mr. Bowen called attention to the fact that the commercial side of every proposition is the one which most appeals to the central station man. Continuing, he considered that the general principles of the business seem to be better settled and more fully grounded and the lines of machine building seems to have reached an ultimate standard, for a considerable time at least, and, therefore, the central station man is very much nearer a standard than ever before. The twin subjects of "Taxation" and "Municipal Ownership" were touched upon, as well as several other phases of the central station business, which are of vital interest to all.

Letters were then read from various sub-committees of the legislative committee, reporting the progress made in their particular States. The committee on membership then recommended a number of applications. It was deemed advisable to continue the committee on uniform advertising, and Mr. H. Almert was added to the same.

After some discussion a motion was carried that the summer meeting be held in September at St. Louis to meet with the other electrical associations and electrical people, the date to be left to the executive committee. It was also decided to send a representative in the person of the secretary, to the convention of the National Electric Light Association, to be held at Boston in May.

The Northwestern Electrical Association is to be congratulated upon the fortunate selection it has made in the person of its new president, T. F. Grover. Progressive, liberal and well versed in his chosen field, he will prove a most worthy successor to the retiring president, F. W. Bowen. Identified with electrical interests since the electric current was first introduced on a commercial scale, Mr. Grover is at home in the lighting and street railway field. Being vice-president and general manager of the Eastern Wisconsin Railway & Light Company, he is a member not only of the Northwestern Electrical Association, but of the National Electric Light Association, the American Street Railway Association and the American Gas Light Association as well. Although born and brought up in New Jersey and the East, he has been in the Northwest since 1892. He was the superintendent of the former Milwaukee & Wauwatosa Electric Company, which he left in 1896 to go to Fond du Lac, Wis. He acquired an interest in and was vice-president and superintendent of the then Fond du Lac Electric Company, which, under Mr. Grover's guidance, has steadily advanced. Having secured a new electric light, street railway and gas franchise, he then formed the Fond du Lac Railway & Light Company, which later acquired the property of the Gas Light Company. In 1899 he built the street railway system in Fond du Lac, which in the following year was extended to North Fond du Lac. In 1902 the Fond du Lac & Oshkosh Electric Railway Company was incorporated, of which he was the general manager and later its president. This company was subsequently absorbed by the Eastern Wisconsin Railway & Light Company. Mr. Grover takes an active part in the affairs of his city and is identified with various commercial enterprises.

T. F. GROVER,
PRESIDENT NORTHWESTERN ELECTRICAL ASSOCIATION.

HEATING FROM CENTRAL STATIONS.

The first paper presented in the afternoon session was one on "Central Station Heating," by W. H. Schott. To judge by the discussion of which this paper was productive, it was a subject which is of great interest to many of the central station men. Mr. Schott considered various features common to all systems, but the question to be decided upon when a central station plant is considered is, "Which shall We Use, Water or Steam?"

Hot water heating is in operation in a great many cities, some using a single pipe circuit system, others a two-pipe static head system, and still others a two-pipe balance column system. The single-pipe system is adaptable only where there is a limited territory to serve; for large areas a two-pipe system becomes necessary in order to give the system the necessary amount of flexibility required and to furnish a positive circulation. Where the district to be served is compact with large buildings, ranging in height from six to sixteen stories, the situation then becomes a steam-heating one, the steam being supplied at low pressure, which may be obtained either from engines or furnished direct from boilers.

Heating plants utilizing either water or steam are found to be a better investment where exhaust steam is used in furnishing the heat, or at least part of it. Where exhaust steam exists and it is desirable to use it, this can be done more economically in a hot water system than in a steam system, due to the fact that it may be used at atmospheric pressure, and at a pressure represented by a 20-in. vacuum during the milder periods, the circulation being made positive by using a pump as the circulating medium.

In a well-designed water system there is only required from ten to thirty pounds pressure to overcome the pressure due to circulation and friction of mains, the power utilized by the circulation being absorbed in the circulating water, so that it is not lost. With a steam system sufficient pressure must be maintained upon the mains to overcome the friction in the street work and to furnish the necessary circulation to the surface which is to be heated, this pressure ranging from 2 to 20 pounds and even higher, but ordinarily at from 5 to 10 pounds pressure.

In taking up the question of a central station heating plant, the territory to be heated should be carefully examined by some one familiar with its needs and then a plant designed that will give an economical operation, together with a superior service to meet the needs as found. Many franchises granted in the past are accepted by companies that should never have been accepted, due to the fact that the rates prescribed were entirely too low, resulting in disaster to the company. The street work should be installed in the best possible manner known, great care being taken to see that the main is of ample capacity, and the expansion taken care of in a proper manner so as not to throw undue strain on any fitting in the system; the insulation should be of the best so as to reduce street losses to a minimum, the pipe lines should be properly under-drained so as to eliminate the possibility of water logging, and in a steam system great care should be taken in the maintaining of drains.

The radiation required for a building should be based upon the minimum temperature, or say 20° below zero. If sufficient radiation is set to maintain the standard temperature, a company is only called upon to operate 40 per cent. of its maximum as an average during the entire heating season. It is an absolute necessity to adopt some

form of regulation, as otherwise a large amount of heat is wasted. Tests made show that a regulator system will save to the central station 40 per cent. of its fuel requirements, which implies that 40 per cent. more business can be carried on a given plant with regulation.

In a well-designed water system during the average temperature of the heating season six to eight pounds of water per square foot of radiation per hour is ample to furnish all the heat required, but when the temperature is 20° below zero twelve to eighteen pounds of water per square foot per hour are necessary, and the plant must have a corresponding capacity. The same conditions practically apply to a steam as to a water plant.

Mr. Schott said that in tests made recently he has found a wider range in a steam than in a water plant. Comparing the tests taken in a building where the radiation set up was up to requirements against one where the radiation was set on a 52 per cent. basis, he found that a change of 34 per cent. in outside temperature varied condensation in the building where radiation was properly set 13.72 per cent. below in the building underset, the same change in outside temperature varying condensation 24.24 per cent.

As to charges for heating a given space, certainly a rate based on cubical contents is entirely wrong. A building, due to its construction and exposures, may vary from two to eight or ten changes of air per hour. These changes govern the amount of heat required to heat the space in question. Necessarily, to heat properly, the radiation must be based upon the maximum number of changes of air that will take place per hour, and as the number of square feet of radiation set governs the operating expenses of a central station, it must in that case be the basis of charge, either on a square foot or on a meter basis.

With the radiation furnished on a square foot basis and without regulation, a price that would justify the company in operating without any restrictions would seem prohibitive, but the application of regulation is practically like a meter service, in not permitting the building to be overheated, but furnishing the necessary heat to maintain 70 or 72°, the temperature usually agreed upon; with consumers securing their heat upon this basis, they are usually much better satisfied than upon a meter basis, and the income of the company per square foot per season should average higher than with a meter basis.

Probably the ideal method of furnishing heat to the consumer from the station standpoint would be through a meter and at the same time give the consumer automatic regulation. The regulator would prevent the building being overheated and insure an even temperature, and at the same time the company would be paid for all heat so supplied.

Mr. Schott presented several charts, showing the regulation obtained in a building without any manipulation of valves. The regulator closes off the circulation from ten to 70 per cent. of the time in each twenty-four hours, depending entirely on the outside temperature and as an average during the heating season will keep the circulation closed off over 40 per cent. of the time.

If a lighting and power company is in a position to furnish heat, in addition to its light and power, it can eliminate a large percentage of the isolated plants, with which they have always to contend. Moreover, a heating plant enables it to fortify its business against municipal ownership and competition. Consequently, in considering the establishment of a plant of this character, there should be considered the advantages to be gained by the operation of a consolidated property, and due credit should be given the heating department for the assistance it renders the lighting department in securing profitable lighting and power business that a company otherwise could not obtain.

In the discussion of Mr. Schott's paper, Mr. Almert asked the yearly cost of coal in a system with a fairly tight boiler and heating plant, heating say 200 or 210 days a year and using coal containing 11,500 to 12,000 B.T.U., costing say $2.25 per ton. Mr. Schott replied that in a test made recently at Purdue University Prof. Goss showed that the cost was 3.8 cents per square foot per season for hot water; the coal tested 10,500 B.T.U., which would put it on a $2.00 per ton basis. "Assuming the same value for the coal, it would cost a fraction under 8 cents per square foot per season. The actual test was 77 pounds of coal per square foot of radiation per season." With a steam proposition, which runs actually 130 pounds per square foot, an estimate can easily be arrived at to determine the cost with regulation. Without regulation, it will run as high as 180 pounds per square foot.

Mr. Kimball said that in Kenosha great difficulty has been met in differentiating between what is properly chargeable to the electric light plant and that chargeable to the heating plant. About 77 pounds of coal are used per square foot of radiation, in addition to the exhaust steam put into the heating system. Mr. Schott added that in the Purdue test everything was not charged against the heating plant. The engines in that case absorbed 7 per cent. of the heat transmitted to them and the pump absorbed 4 per cent. When it came to condensation, the engines tested at 28½ pounds and the pumps 95½ pounds per indicated horse-power per hour. and everything was charged against the heating plant except the actual heat units absorbed by the engines and pumps. The test proved that the difference in favor of regulation is just about 40 per cent. One should get at least 40 per cent. more for heating without regulation than with it. He said that the amount of heat given off governs the amount of coal burned, and the number of degrees drop in water depends upon how the plant is being worked. Some plants will work on as little as 10° or 12° difference, some 15° to 20°, and we have them as high as 30°. The heavier the load on the plant, the greater the drop will be in the water, on an average.

Mr. Kimball added that in some tests that were recently made the return temperature where regulators were not working was greater; more water was being pumped than where the regulators were operating; but as far as 40 per cent. difference in operating is concerned, he did not figure that the gain in economy would be as much. As to distribution losses, Mr. Schott said he had undertaken to arrive at the street losses, but was not quite satisfied; the tests should continue for a week or ten days and an average taken. In reply to a query, Mr. Schott said if at a temperature of 200° not less than 246 heat units will be given off for each square foot of radiating surface. At 170° there will be 170 units and at 160° 155 units; 160° is the average temperature carried throughout the heating season, providing the radiation is figured on that basis. It is another proposition to fix the radiation on a 210° basis so as to take care of the space at 20° below zero. It takes more radiating surface with the circulating water at 160° than at 210°. The drop in temperature, on the ordinary average distance, which is about half a mile, should not exceed two to three degrees as a maximum. The question of drop in the supply is usually figured on the basis that when the pipe line is handling 60 per cent. of its capacity, a change of water should take place within an hour's time. This might be increased, but when a line is working above 60 per cent. capacity, this should not exceed 2°, and it is being done on less than one. For average conditions 30° difference between supply and return at the power house is an average for standard practice. The difference in the temperature between the supply and return going in and out of a house should not exceed 12°.

Mr. Harding said that in the operation of his plant, which is one of the oldest in the country, it has been found very much better results are obtained by adjusting the houses to a drop of 40° than where running with a drop of from 25° to 30°. Mr. Schott said in the case of consumers taking water for domestic purposes, a boiler is placed in the return end of the line, and a meter connected. He did not consider it a good proposition to sell hot water.

In reply to a question as to how many average feet of radiation can be taken care of per horse-power of exhaust steam from the engine in the case of hot water heating, Mr. Schott said the average during the season will be 17,500 and on the basis of a temperature of 10° below zero, it will take care of a fraction under 10,000. "Assuming radiation as figured from a proper standpoint, and not throwing onto it a double condensation, this figure is more like 6,800 square feet. This is on the basis of 100 hp." As to the relative amount of horse-power required in a building for heating and for lighting, that depends entirely upon the character of the building. Assuming a store there will be a surplus of steam at all times required for lighting over and above that which is required for heating. In the case of a certain building of sufficient size to require 17,000 ft. of radiation to heat it with steam under normal conditions, 170 hp are required. The load on the electrc end runs as high as 350° and averages about 200 hp, so that the exhaust steam will more than heat the building. In this particular case the owners have agreed to take their heat and power from a central station company, with a minimum guarantee that it will not run over $15,000 a year.

COIL WINDINGS FOR ELECTRICAL PURPOSES.

The next paper to be presented was one on "Coil Windings for Electrical Purposes," by Messrs. Richard Varley and Charles R. Underhill. As there is very little data on the subject and the re-

quirements are so exacting the practical method of obtaining data has been to construct electromagnets of different forms and sizes and make actual tests. Having once found the pull which may be produced through various distances with different magnetizing forces, it is then comparatively easy to determine what size of wire should be used for any given voltage to produce the desired results. The paper then took up various points concerning the manufacture of electromagnets and developed formulæ whereby it is possible to quickly determine the proper size of wire for any purpose.

ELECTROLYTIC RECTIFIERS.

In the absence of the author, a paper on "Rectifiers," by W. Scheidel, was read by the secretary. This dealt more in particular with the construction of an aluminum rectifier which has recently been placed in the market for the charging of storage batteries from alternating-current lines. The main feature is the use of an inactive electrode between the two active electrodes; the former is connected to the middle point of a transformer secondary, and the two latter to the secondary terminals.

INCANDESCENT LAMPS AND THEIR SMASHING POINT.

The last paper to be read at the afternoon session was one on "Incandescent Lamps in General, their Smashing Point in Particular," by George C. Keech. From the very birth of the "smashing point" expression came the thought that the next step toward the ideal lamp was to make one which would automatically die when it had lived out its usefulness. After pointing out the desirability of keeping the illumination up to the standard, the paper then outlined improvements in the process of manufacture whereby, although exactness is not possible, lamps are made which will burn out very close to such a point, and the important result is practically obtained. Such lamps will smash automatically and must be renewed. In the discussion Mr. Keech, in answering to a question as to what he considered a proper "smashing point," said that this is when the candle-power falls to 80 per cent. of normal, or 12.8 candle-power. In reply to a question he said the candle-power are for 3.1 and 3.5 watt-lamps; about 7,200 and 13,800 hours, respectively. Mr. Schott said that the frequent changing of lamps is a good thing to maintain candle-power, but the tendency of cities is to force companies into lower rates, and it is an open question whether they can go to too great expense to maintain it. In reply Mr. Keech said that the average burning of a lamp is, say, two hours per night, and one lamp at half a cent would bring in a revenue of one cent per night; fifty lamps, fifty cents; and in 365 nights those fifty lamps would bring in about $180. In that way fifty dead lamps on the line, if they had been burning, would have meant the sale of $180 worth of current; and, of course, the central station man expects to make his money out of the sale of current. Mr. Schott reported his experience that the average renewals are about a lamp per year for the connected load. For instance, with about 7,000 lamps connected with a station, about 7,000 would be the average number of renewals, which statement applies particularly to a residence territory; if a commercial plant, the percentage of renewals will materially increase. In the ordinary country plant, where anywhere from 30 to 60 per cent. of the connected load is for residence use, about one lamp per year for each lamp connected would be a fair average to consider. In a town of ten to 12,000 inhabitants, 7,000 lamp renewals would cost about $1,400. He uses a 52 to 57-watt lamp (55 on an average). An increase in voltage of 1 per cent. means an increase in candle-power of 6.2 per cent. and an increase in life of 25 per cent. Mr. Keech said that by burning a lamp 3 per cent. high its life will be cut in two, no matter what the efficiency is. A 3.5 watt lamp, burning 3 per cent. high, will last about 54 per cent. and a 3.1-watt lamp on the same circuit will last about 50 per cent. of its life, on the average, because the 3.1-watt lamp is more delicate. In the case of a 110-volt lamp run 3 per cent. high, it would make a 16-cp lamp give 19 cp. The wattage would be forced up about one watt to a volt and the lamp would practically give out 19 candles at 60 watts, which is just about 3.1. As a consequence, a 16-cp lamp burned 3 per cent. high will result in increasing the watts a little, so that when you divide 19 into 59 watts you have a 3.5-watt lamp, which brings it back to where it was in the first place, and the efficiency remains the same.

Mr. Schott considered that one of the worst features to contend with in plants in small towns is the fact that the consumer expects to take one lamp and make it do the work of two. If a filament is white, the average consumer will think it is giving more light than a red one. In large cities where they are educated in this manner and put in the proper number of lights, you can run your lamp under voltage a little bit, and give satisfaction, but in a typical country plant you have to vary from good practice to satisfy your customer and yourself.

DOUBLE-CURRENT GENERATORS.

On Thursday morning Mr. W. L. Waters presented a paper entitled "Double-Current Generators in their Connection with Double-Current Supply," in which he pointed out that the double-current generator offers the best solution in cases where a station supplies both alternating and direct current, owing to the saving both in the first cost and operating expenses. The efficiency is also higher than when rotary converters or motor generator sets are used. The main objection is that the voltage of the alternating-current side of the machine bears a different ratio to that on the direct-current side; that one cannot be varied without the other, and variation of the load on one side affects to a slight extent the voltage on the other side. The relative weight of these objections must be decided in each individual case. From the manufacturer's point of view the great objection to double-current generators is that they are special machines, usually requiring new designs and special patterns and dies.

It was pointed out that some standard direct-current generators can be very conveniently used as double-current generators with only a very slight change in the speed. For example, a standard 2,500-kw, 250-volt engine type machine can make a very good 25-cycle double-current generator, the only change being to provide the machine with collector rings, increase the air-gap, and put more copper on the field magnets in order to make the machine regulate properly when running as an alternating-current generator. These changes would not increase the cost of the machine more than 20 per cent. On the other hand, if a 500-kw, 500-volt engine type machine were taken, it would mean very radical changes to make this into a 25-cycle, double-current generator; 25 or 40-cycle machines are not in any way difficult to design, but in the case of 60-cycle generators difficulties are encountered with the commutator on account of the high peripheral speed; 60-cycle, 600-volt, double-current generator and rotary converters can be made to work, but they are not as reliable as those for lower frequencies, and there is no brush gear at present on the market which is quite satisfactory for the commutator peripheral speeds necessary in a 60-cycle, 600-volt machine. It appears that the most satisfactory 60-cycle, double-current generators will be those driven by steam turbines, and it looks as though this prime-mover would solve this problem.

In summing up Mr. Waters says that, generally speaking, 25-cycle, double-current generators, if of large size, can be direct-connected to the engine, while for sizes smaller than 500 kw they are better belt-driven; 40-cycle machines should always be belt-driven if the cost is to be reasonable, while for 60-cycle, double-current generators, apparently the only reasonable solution is to have steam turbine sets. Of course, double-current generators can be made for any frequency and voltage up to 60 cycles, 600 volts, and for any speed desired; it is simply a question of dollars and cents whether one wishes the most reasonable prices and the quickest deliveries and to have machines which, when second-hand, will be something more than scrap. They should consider the matter of frequencies and outputs when laying out a station for double-current supply.

The discussion of Mr. Waters' paper more particularly related to the construction of double-current generators, and not with the practical application of these to central station work. The president remarked that the use of double-current generators was one of expediency with each individual station. As it is seldom good practice to run an engine underloaded below, say, 50 per cent., it is such a condition to which the double-current generator is especially applicable.

RECTIFICATION OF ALTERNATING CURRENTS.

The convention then listened to the reading of a paper on "Rectifiers," by C. F. Burgess, assistant professor of electrical engineering at the University of Wisconsin. This paper more particularly dealt with the theoretical aspect of the subject, and indicated the direction in which practical results may be expected. Rectifiers were divided into three general types: mechanical, vapor and electrolytic. Omitting the rotary converter, which is essentially a direct-current dynamo driven by an alternating-current motor, and is not a rectifier in the commonly accepted meaning of the term, the mechanical rectifiers include the synchronously-driven rotating reversing switch, and the vibrating reverser in which the contact-maker is maintained in synchronous vibrations by energy derived from the alternating circuit. Various inherent defects have prevented these devices from being extensively adopted in spite of their low cost, as compared with the rotary converter.

A class of electrolytic rectifier only recently placed upon the market in this country is sometimes designated an electrolytic valve, and, as such, has an analogy in the hydraulic check valve, which automatically allows water to flow freely through a pipe in one direction, but prevents its passage in the opposite direction. With the commercial frequencies now employed, of from 25 to over 100 cycles per second, it is evident that this valve must act with great rapidity. As the result of laboratory investigation, it has been shown that an aluminum plate immersed in a sodium nitrate electrolyte required about 1/1100 second for closing the electrical valve at each reversal of pressure.

Among the advantages of such a rectifier are that it possesses no moving parts; it is a close approximation to the static alternating-current transformer, requiring little or no attention during operation. The materials of which it is constructed are cheap, and the total cost should be lower than that of the ordinary transformer of equivalent outputs. The electrolytic rectifier has a high power factor. It requires little or no abnormal rush of starting current. In its present condition, it has an efficiency in the neighborhood of 50 per cent. In small sizes this form of rectifier is especially advantageous for the charging of small storage batteries from alternating-current circuits.

With aluminum electrodes 2 x 1 x 1½ in., a normal load of 10 amp. can be obtained at a rectified pressure of 25 to 50 volts. The current may be several hundred times higher than this value for a short time, without detriment, and a 50 per cent. overload causes excessive heating and vaporization of the salt, only after several hours' run. The total weight of an output of this capacity is about 30 pounds, most of which is in the transformer. The greatest use which the electrolytic rectifier finds at present is in the charging of storage batteries for various purposes, and its commercial introduction will afford an additional market for the central station product.

The discussion served to show that the future of the rectifier in smaller sizes is a promising one, and that although the efficiency may not be as high as may be desired, it nevertheless will fill a want for the charging of storage batteries for automobile and other purposes.

STANDARD ALTERNATING-CURRENT PRACTICE.

The first paper to be read at the Wednesday afternoon session was on "Standard Practice in the Use of Alternating-Current Electrical Apparatus," by J. J. Gibson. In the absence of the author, Mr. J. R. Kimball read the paper. Referring to the revolving armature generator, it was stated it still retains some advantages for both belted and direct-connected units in the smaller sizes; but the revolving field generator has become a fixture for all others. The question of direct-connected versus belted units is one which has been quite definitely decided in practice. The question of synchronism in throwing alternators together in parallel, is most frequently determined by the lighting up of the synchronizing lamps when the machines are in parallel. The most satisfactory method, however, has proved to be the one employing a synchrnoscope, as it has the advantage of the lamp method because it shows the slightest difference in phase or frequency, whereas lamps do not. As to frequency, for a pure and simple power proposition, 25 cycles has come to be standard. It gives low speed for motors, and although rotaries are successfully built and operated on 60-cycle systems, still the design of the 25-cycle rotary is less difficult and expensive. For lighting and power 60 cycles per second has come to be the accepted standard, as this frequency is not too high for power, either in motors or rotary converters, and it is about the lowest allowable frequency for successful operation of arcs and incandescents.

As to choice of number of phases, stations carrying an incandescent lighting load alone, with no prospect of ever having a power load, should use single-phase apparatus. A single-phase distribution is not suitable for the operation of motors. It is necessary in a station carrying a mixed load to use polyphase generators, which supply different systems of feeders—polyphase feeders for power circuits, and single-phase feeders for lighting circuits. Three-phase distribution for power calls for about three-quarters of the copper which would be used in two-phase distribution. On the other hand, it is easier, on a lighting load, to keep two than three phases balanced, and the lowering transformer equipment is more expensive in three-phase distribution. For a station, therefore, operating a mixed load, where lighting predominates, two-phase is far better than three-phase. When the power load increases to a point where 25 per cent. of the copper in that branch of the service becomes a considerable item and amounts to more than the saving in transformers, then three-phase distribution is the proper thing to use.

For transmission lines three-phase is universally adopted, although in stepping down for distribution from transmission lines, the current is very often changed to two-phase, in order to obtain the benefits of such regulation. As to choice of voltage in the case of central stations operating lights and motors, 1,100 and 2,200 volts are at present standard. Where necessary alternators can be wound to deliver 6,600 to 11,000 volts. For industrial plants, where the current must not be sent a very long distance, 220 or 440 volts are used, thus doing away with the necessity of lowering transformers. Mr. Gibson considers that the single-phase transformer is best, and that the three-phase transformer will never be more than a specialty. The induction motor, although essentially a constant-speed motor, like the shunt-wound, direct-current motor, is being applied to variable-speed work. Synchronous motors are the exception, and not the rule, and in very many cases are being discarded for the induction motor. Double-current generators are specialties, and not standard practice. Alternating-current arc lamps are finding extensive application as they enable the central station man to use one system for all classes of service.

STORAGE BATTERIES IN SMALL CENTRAL STATIONS.

Mr. J. H. S. Waring then read a paper in which he took up the specific cases of a lighting station in a typical small village and showed the benefit of installing a storage battery in connection therewith. In this case it usually proves unprofitable to furnish continuous service throughout 24 hours, owing to the small demand during the early morning hours and during the greater portion of the day. On the other hand, a central station operating only on the night schedule is greatly handicapped since the owners of residences naturally demand lighting during all hours of the night, and would probably desire fan service throughout the day during the summer months.

The plant considered consists of one 60-hp and one 120-hp non-condensing engines, which, in addition to driving certain machinery, operate two 220-volt geerators, one of 20 and the other of 25 kw, connected to a three-wire system with 220 volts across the outers. The maximum peak load of 150 amp. was on the station for about an hour and a half in the evening; that is, from 6.30 to 8 P.M. It then gradually decreased to about 10 amp. at 11 P.M. and at midnight the plant was shut down. A storage battery was then put in; the machinery operated the same number of hours as previously, and current supplied from the storage battery for the remainder of the day. A 110-volt battery was installed, and the two outer wires connected together at the station, the system thus operating as a two-wire, 110-volt system with a considerably less drop than when operated as a three-wire system with maximum load. There was an increase in load after the installation of the battery of about 60 per cent. and an increased fuel consumption of only about 25 per cent., showing that the cost of fuel per kilowatt-hour was decreased about 37 per cent., which decrease was due to the fact that the generator set while operating with the battery was run at a considerably higher percentage of full load than previously.

Another case was cited of a plant which supplied current to outlying districts. While the alternating load was extremely heavy during the peak, it was very light during the day, consisting only of a small amount of fan service in the summer months. A battery was installed in this plant which furnished current directly to the direct-current motors and at the same time operated a direct-current motor running a small alternator, so that the fans on the alternating-current system could be used.

Another application of the storage battery referred to and irrespective to the size of the plant, is in connection with a water power plant. There are many cases where there is sufficient water power to supply considerably more than the load existing during the greater part of 24 hours, but not sufficient for the peak load. In this case the generators, while carrying the day load, can charge a battery, the same being discharged at the time of the peak load.

Another application of the storage battery referred to is that of placing it at the center of the load of a direct-current system of distribution. When the volume of business in a congested locality reaches a certain volume (and the more remote the sooner is this point reached), the amount of copper required to care for the power from the station tends to render this system of distribution impracticable. By the installation of a battery of sufficient capacity

to care for a certain portion of the peak, the amount of copper between the central station and the center of the load is decreased to such an extent that the battery investments is decidedly a good one from the commercial standpoint. A recent adaptation mentioned of the storage battery is its use with direct-current exciters in alternating-current power and lighting plants. With a storage battery floating at all times on the exciter, power interruptions of current in the exciter circuit are practically obviated, fluctuations on the exciter voltage are reduced with corresponding reductions in the alternating-current voltage fluctuations. Where alternating-current motors are used to drive the exciters, the battery also serves to supply field current when starting up the plant after a shut-down.

At the conclusion of his paper, the author showed a number of lantern slides, which served to illustrate some points of interest in lighting work and storage batteries. Among others was shown the new type of negative plates of the Electric Storage Battery Company, known as the box negative. In this plate the active material is held in place by perforated lead sheets on each side of the plate, which thus prevents the loss of the active material. In a laboratory test, after 8,000 complete discharges of the plate, a depreciation of less than 1 per cent. was noticeable.

In answer to a question, Mr. Waring stated that the latest practice of his company was to place wooden separators in the battery after they had been in operation for about a year. Mr. Lukes cited the advantages of the storage battery on railway circuits in order to prevent the abrupt fluctuation. These fluctuations are very severe, the load changing from almost zero to perhaps 50, or even as high as 150 kw. Mr. Waring said the use of a storage battery in conjunction with a street railway plant is perhaps the most common application of storage battery work in large stations. One application is to take off the fluctuations of the railway load, so that all machines may be belted to one shaft, thus avoiding trouble with regulation on lighting circuit. In a recent case a firm of consulting engineers made a test on an interurban system where there were three sub-stations with a storage battery in each. They made a test of a sub-station, running with the rotaries alone, the batteries being out of service; the next test was made with the battery running without a booster, the battery merely floating; and the third test was made with the battery operating with booster in conjunction with rotaries. In that case the fluctuations either side of the average voltage were 3 per cent. on a 600-volt system, when the battery was operating with booster; when the battery and booster were off the voltage fluctuation was 16 per cent. under just about the same load variations. In that case they were not aiming at voltage regulation, because it made no difference whether the rotaries did vary somewhat, but that may serve as an illustration of what it will do. In reply to a question, Mr. Waring said that in most interurban practice he figures on certainly not over 100 watt-hours per ton-mile for cars, and the starting current will vary from two to three times the average current. That does not mean necessarily a large-sized battery, because the battery only has to take care of the fluctuation momentarily, and not for any length of time.

THE CURTIS STEAM TURBINE.

Mr. James Lyman presented a paper with this title, which opened with an account of the fundamental principles of the steam turbine, and compared the Curtis type with those of Parsons and De Laval. The former was then described in detail and its advantages over the reciprocating steam engine pointed out. With respect to regulation, it was stated that in the case of a 1,500-kw Curtis turbine with a mixed load of lighting, induction motors and railway power with momentary fluctuations of 200 kw, the load ranging from 500 to 800 kw, the speed varied less than 2 per cent., with the boiler pressure varying all the way from 75 to 150 pounds. It was added that no reciprocating engine could give such regulation. Experience with Curtis turbines in operation and deductions from their form of construction, show that the repair account will be exceedingly low, making a large saving as compared with the operation of reciprocating engines. One of the advantages adduced in favor of the Curtis turbine is that, when used in connection with steam heating plants, it can be changed from condensing to non-condensing without shutting down. The heating system can be connected with the first stage or free exhaust and regulated for several pounds back pressure by adjustment of the second stage valves; thus, where all the exhaust system is not required for heating, it can be efficiently used by the turbine. Another advantage noted is that the Curtis turbine in running is almost noiseless. Following is a list giving the sizes of Curtis turbo-alternators now made by the General Electric Company: For 60 cycles; 500 kw at 1,800 r.p.m.; 1,500 kw at 900 r.p.m.; 3,000 kw at 600 r.p.m., and 5,000 kw at 514 r.p.m. For 25 cycles: 2,000 kw at 750 r.p.m., and 5,000 kw at 500 r.p.m. It was stated that the General Electric Company has sold 122 turbo-alternators aggregating 206,500 kw; 25 of the units have already been shipped and about half of them are now in regular commercial operation.

RADIUM AND RADIOACTIVITY.

The last number on the programme was an illustrated lecture on "Radium," by Prof. R. A. Millikan, of the University of Chicago. This was a pleasing diversion from the technical papers discussed at the convention, and, furthermore, was a very instructive lecture on a subject which is arousing the greatest interest, not only among scientists, but among laymen as well. The lecturer treated the subjects under the following heads: Discovery of X-rays; discovery of radioactivity; discovery of radium; nature of cathode rays; new theory as to the constitution of matter; nature of X-rays; radioactive substances emit cathode rays; other radiations from radioactive substance; nature of alpha-rays; the Crookes spinthariscope; continuous emission of light and heat by radioactive substances; radioactivity a manifestation of subatomic energy; production of uranium rays; the emanations from radium; induced radioactivity; the birth of helium; the life of radium; the transmutation of the elements; sub-atomic energies.

As will be seen from the above enumeration, the lecture covered a great extent of ground. The historical development was considered in each case and the views by different authorities as to the nature of the various radioactive phenomena given. In conclusion, Prof. Milliken says that the studies of the last eight years upon radiation seem to indicate that in the atomic world at least some of the heaviest and most complex atomic structures are tending to disintegrate into simple atoms. The profoundly interesting question is thus suggested whether there is any natural process which does, among the atoms, what the life process does among the molecules, namely, which takes the simpler forms and builds them up again into more complex forms. Prof. Milliken thinks that it would be rash to attempt to give any positive answer to such a query, yet the fact that radium now exists on the earth, taken in connection with the fact that the life of radium is short in comparison that the ages the earth has been in existence, certainly seems to point to an affirmative answer. The experiments of the last eight years have marked a remarkable advance in science in that they have proven the existence of an immense store of sub-atomic energy. It seems highly improbable, however, that this energy can ever be utilized on the earth to serve man's economic needs, for thus far we know of but three substances which are disengaging this sub-atomic energy and these are changing so quickly that the rate of evolution of energy is almost infinitesimal. Radium may possibly prove to be of some practical value in the cure of diseases, although it is too early yet to ascertain this with certainty. But even if no practical application of this discovery should be found, radioactivity will, nevertheless, have served the most useful of all ends, namely, that of enlarging man's knowledge of the ways of nature and of deepening his insight into the constitution of matter.

The report of the nominating committee, which submitted the following names for officers and directors for the following year, was adopted, and the following declared elected: For president, T. F. Grover, Fond du Lac, Wis.; first vice-president, George H. Lukes, Evanston, Ill.; second vice-president, E. A. Daniell, Menominee, Mich.; secretary-treasurer, Thomas R. Mercein, Milwaukee. Directors—W. H. Schott, Chicago; D. C. Jackson, Madison, and H. Almert, Oak Park, Ill.

Thursday evening the annual banquet was held at Hotel Pfister, as usual.

The following members were in attendance at the convention: T. F. Grover, vice-president and general manager Eastern Wisconsin Railway & Light Company, Fond du Lac, Wis.; C. F. Burgess, assistant professor of electrical engineering, University of Wisconsin, Madison, Wis.; L. Owen, assistant superintendent Peoria Gas & Electric Company, Peoria, Ill.; J. H. Harding, treasurer and superintendent La Porte Electric Company, La Porte, Ind.; George H. Lukes, general superintendent North Shore Electric Company, Evanston, Ill.; Harold Almert, manager Cicero Light, Heat & Power Company, Oak Park, Ill.; R. Kimball, vice-president and superintendent Kenosha Gas & Electric Company, Kenosha, Wis.; H. W. Frund, secretary and manager the Vincennes Electric Light & Power Company, Vincennes, Ind.; F. W. Bowen, president; Thomas R.

Mercein, secretary; J. S. Allen, Beloit Electric Company, Beloit, Wis.; Irving P. Lord, Waupaca, Wis.; H. F. Pearce, Negaunee, Mich.; G. R. Lindsay, Manawa, Wis.; P. H. Korst, Janesville Electric Company, Janesville, Wis.; Edward Danfield, manager and secretary, Menominee & Marinette Light & Traction Company, Menominee, Mich.; P. L. Utley, manager Watertown Electric Company, Watertown, Wis.; Fred W. Insull, secretary North Shore Electric Company, Evanston, Ill.; William B. Jackson, Madison, Wis.; Mr. Rau, the Milwaukee Electric Railway & Light Company, Milwaukee, Wis.; D. B. Bronson, Chicago Edison Company, Chicago, Ill.; G. N. Eastman, Chicago Edison Company, Chicago, Ill.

The Lamme Single-Phase Series Motor.

The first issue of the *Electric Club Journal*, published by the Wilkinsburg Electric Club, contains an article by Mr. Charles F. Scott, entitled, "The Single-Phase Series Motor in Its Relation to Existing Railway Systems." After sketching the development of the electric railway and its present status, and pointing out how the advent of the series alternating-current motor has created a radical new situation in the electric railway field, it is stated that at first a frequency of 16⅔ cycles was employed for the Lamme single-phase motor, but experience gained in the construction and tests of a number of motors have led to the design of motors for 25 cycles equal in performance to the earlier motors at the lower frequency. The adoption of this frequency, moreover, makes present alternators available for the operation of the alternating-current motor, and, in fact, they may be used for supplying current to the cars equipped with the new motor and for supplying direct current through rotary converters to old cars.

It is stated that an unique feature of the alternating-current motor which is now being considered is its conformity to the standard type of direct-current motor. The former is also a first-class direct-current motor, being a type that can be operated indifferently on alternating current or on direct current. While this characteristic will be of little or no consequence with respect to new installations, there are many cases where it is necessary or at least desirable to operate from a direct-current trolley. Lamme single-phase series motors are normally wound for 250 volts, so that if two are connected in series they can operate on a 500-volt direct-current circuit. Two single-phase motors connected in series can take the place of one direct-current motor, and a four-motor equipment motor, therefore, may be operated with the ordinary direct-current type of series parallel control. A two-motor alternating-current equipment, if operated by direct current, would make it necessary that the whole control be by means of a rheostat in the same way that a single direct-current motor would be operated.

An equipment of single-phase motors with rheostatic control may be operated either on a 500-volt, direct-current circuit or on a 500-volt alternating-current wound circuit, or on a high-voltage trolley circuit of, say, 1,000 to 3,000 volts, the voltage being reduced by transformers on the car. A given car, therefore, may start in a city which has a 500-volt system, running along with local cars from the same direct-current trolley; it may then go across country with alternating current at high voltage and then through a village taking alternating current at 500 volts, and then take high voltage again, as may be convenient. It is true that this arrangement will prevent the use of variable voltage control. The advantage in voltage control, however, is greatest in those cases where stops are frequent, or where the motor is run at low speed during a considerable portion of the time, as it is in these cases with rheostatic control that the rheostat is in service a considerable part of the time with corresponding loss; but the loss in the rheostat of an ordinary suburban car will be relatively small if stops are infrequent. It is, theoretically, possible to install both the rheostatic and the voltage control on the same car, but in general this is not advisable on account of the weight, cost and complication of the double system of control.

More Radium.

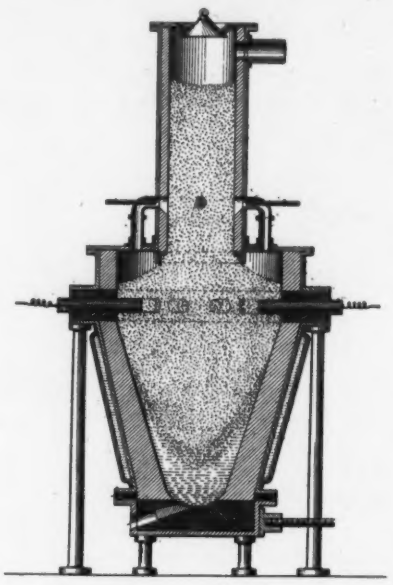
The State of Texas is the latest aspirant to the honor of being a radium-producing region. According to a press dispatch from Austin, vast quantities of earth containing radium compounds have been discovered in the Llano mineral region near that city. It is further asserted that scientists claim that these earths will yield more radium than any other known deposits in the world.

Recent Electrochemical Developments.

RESISTANCE FURNACE FOR THE MANUFACTURE OF CALCIUM CARBIDE.

Three patents were granted on January 19 to Mr. Alfred H. Cowles, of Cleveland, Ohio, all referring to the manufacture of calcium carbide in an electric resistance furnace. He proposes to pre-heat the charge, for example a mixture of lime and carbon, by withdrawing the waste carbon mon-oxide from the furnace and burning it in the pre-heating chamber. The resonance furnace itself is so designed that the current density increases towards the bottom of the furnace so that the temperature is highest at the bottom, thus giving a sufficient fluidity to the calcium carbide to permit it to be tapped.

The adjoining illustration shows one of the various furnaces for this purpose. It is an annular stack of refractory non-conducting material, enclosed by a casing of iron. The major portion of the body is a downwardly-converging bosh surrounded by a water jacket. The hearth of the furnace consists of a solid mass of carbon set in an iron casing which is insulated from the upper casing of the furnace. A



CALCIUM CARBIDE FURNACE.

tap-hole for the molten product extends through the hearth. The hearth serves as one electrode, while the other electrode consists of a number of radial carbon rods passing horizontally through the side walls of the furnace near its top.

Supported upon an opening into the upper end of the furnace is the pre-heating chamber, consisting of a shell of iron with a lining of refractory material. The upper end of the pre-heating chamber has a *bell-and-hopper* charging mechanism. Pipes for withdrawing the combustible gases from the electric furnace extend upwards through its top and are connected to burners with air-blast pipes, which enter openings in the sides of the pre-heating chamber.

BATTERY INVENTION.

A patent granted to Mr. Oskar Frank, of Detroit, Michigan, refers to the mechanical construction of a grid for pasted storage battery plates. Another patent granted to Mr. F. A. Feldkamp relates to a method of producing a storage battery plate. A perforated metal plate is wrapped in layers of an open-mesh fabric such as mull, linen, mosquito netting, etc., and the active material in a plastic state is pressed into the layers of fabric.

ELECTROLYTIC EXTRACTION OF GOLD.

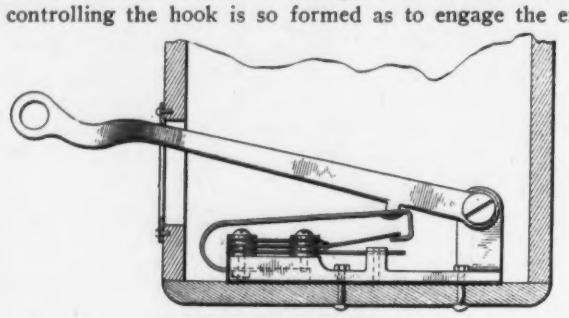
Two recent patents granted to Mr. H. R. Cassel, of New York City, refer to a method and apparatus for extracting precious metals by electrolysis. In the electrolytic vat the anodes and cathodes are vertically arranged, and the pulverized ore, after having been converted into a pulp mixed with cyanide of potassium, is introduced into the vessel. The stream of constantly flowing pulp is diverted to the anodes, the particles of gold being thus brought into intimate contact with the same and rapidly dissolved. The cathodes are continually covered with mercury so that the gold is precipitated upon the cathodes as an amalgam. Means are provided by which the pulp

is constantly circulated through the vat from the top to the bottom and then through a pipe back to the top. Means are also provided for continually amalgamating the cathode by a circulation of mercury, the cathodes being blanked by a number of slats or deflectors which are inclined from top to bottom toward the cathodes and serve to continoually throw the mercury as it rebounds from the cathode back upon the same, and effect the rapid accumulation of amalgam. The mercury which collects in the bottom of the cell is returned by means of a pipe to an acid chamber at the top where any alkali in the mercury is neutralized.

New Telephone Patents.

NEW FORM OF HOOK SWITCH.

The telephone hook switch has undergone a very considerable change in the last few years, the older type in which the hook itself sufficed for a switch blade having been almost entirely superseded. Of the superseding types, that in which the hook serves as a switch lever operating upon a key composed of flat springs is the most prevalent. Many admirable varieties of such a hook-switch have been developed, the latest being that described in a patent recently issued to E. E. Yaxley, of Chicago. A side view of this switch is shown in the figure. As will be noted, the spring controlling the hook is so formed as to engage the extrem-



YAXLEY HOOK SWITCH.

ities of all of a nest of springs assembled in the manner customary for switchboard keys. The uppermost spring is bent so that its extremity lies in the same horizontal plane as the middle spring, both springs normally resting upon an insulating bridge underneath which the movement of the lowest or bell spring takes place. The American Electric Telephone Company, of Chicago, has obtained the patent for this excellent switch.

NEW SIGNALING CIRCUITS FOR TWO-WIRE SWITCHBOARD.

A modified system of circuits for signaling in connection with two-wire central energy switchboards forms the subject of a patent granted to K. B. Miller, of Chicago, and assigned by him to the Kellogg Switchboard and Supply Company. The novelty lies in the supervisory circuits in which a plug socket switch is so associated with the lamp circuit that this circuit is opened whenever the plug is in the seat. By the use of such means one relay in the cord circuit is sufficient to properly control each signal, instead of the two usually required. The ultimate economy of such an arrangement is, of course, extremely questionable because of the uncertain habits which experience has shown plug socket switches to possess.

PARTY-LINE DEVICE.

It is, of course, a well-known fact that with party-line working any subscriber may ordinarily hold up a whole line by allowing his receiver to remain off the hook. Undoubtedly here and there considerable difficulty is found from this cause especially on lines where there is a particularly irritable subscriber. Therefore, the idea of Mr. N. E. Noistrom of overcoming this difficulty by bringing the control of the connection between each station and the line into the hands of the central office operator would be an admirable one, provided it could be obtained with less cumbersome apparatus. Unfortunately, he has worked out the problem for a step-by-step party line system and his solution is, therefore, subject to all the limitations of such a system.

Use of the Electrophone.

In connection with a recent tariff speech by Mr. Joseph Chamberlain at the Guildhall, London, the *Evening News* issued an electrophone edition, containing a verbatim report on sale fifteen minutes after the delivery of the speech.

CURRENT NEWS AND NOTES.

TELEPHONING FIRE ALARMS.—It has been the practice of the Wisconsin Telephone Company in Milwaukee to suggest in its telephone directory that patrons send in fire alarms by telephone. The chief of police has requested the manager of the telephone company to omit this suggestion from the book hereafter, for the reason that it frequently takes too long a time to notify the fire headquarters by telephone. This delay gives the fire a chance to gain a good headway before the department is able to respond to the telephone fire call.

HARVARD UNIVERSITY AND MASS. INST. OF TECHNOLOGY.—A press dispatch from Boston states that an alliance of Harvard University and the Massachusetts Institute of Technology is a future possibility. It is pointed out in the dispatch that such an arrangement would be merely an alliance, and not an absorption of one institution by the other. The result would be the limitation of the Lawrence school at Harvard to pure science and the transfer of all Harvard engineering instruction to the Institute of Technology. What is drawing the attention of the Harvard overseers and the technology corporation to the suggestion, the dispatch adds, is the economy and the idea of stopping the actual waste of money and energy involved in the upbuilding and maintenance of two rival technical institutes three miles apart. The project is yet in an embryotic state, and no direct negotiations have yet been undertaken.

CINCINNATI MEETING OF A. I. E. E.—The Cincinnati local branch of the American Institute of Electrical Engineers held its first annual meeting at the Grand Hotel on the evening of January 18. The business meeting was preceded by a dinner in which forty members, associates and guests, participated. The following officers were appointed: Chairman, Mr. B. A. Behrend, chief engineer Bullock Electric Manufacturing Company; vice-chairman, Mr. J. Hendrick Hallberg, general superintendent Cincinnati Gas & Electric Company; secretary and treasurer, Mr. Louis E. Bogen, civil and electrical engineer Bullock Electric Manufacturing Company, late professor of Electrical Engineering at the University of Cincinnati. After the business meeting the chairman introduced Louis Trenchard More, professor of Physics at the University of Cincinnati, who delivered an instructive, interesting talk on radium, exhibiting several photographs taken with radium and also a specimen of radium chloride. The lecture was followed by a general discussion on the new ideas in molecular physics and the great scientific importance of radium in such questions as the age of the earth and the revision of our views of the molecular theory of matter. The local branch has been started with energy and enthusiasm, and the management is arranging with able and representative engineers to lecture before its members.

INDIANA ENGINEERS' SOCIETY.—The 24th annual convention of the Indiana Engineers' Society was held in Indianapolis on January 14, 15 and 16. In his annual address, President R. L. Sackett dwelt upon the evolution of the engineer. Several papers relating to electrical subjects and development were read. The report of the committee on electrical engineering stated that progress was so great that it was difficult for the most diligent engineers and students to keep up with it. Among the many papers read were the following: "Smoke Prevention," by R. P. King; "A Description of the New Centralized Power and Heating Plant at Purdue University," Prof. J. D. Hoffman; "Power Chains and Their Uses," by C. H. Hills; "The Railway Profile Considered with Reference to the Propelling Power of Locomotives or Electric Railway Motor," by Prof. W. D. Pence; "The De Laval Steam Turbine," by G. A. Young; "Interurban Railways in Small Cities," by J. W. Fulwider; "Special Street Railway Work," T. B. McMath, and "Surveys for Electric Railway Construction," by C. L. Sellers. As to electric railway engineering it was claimed that a level track was by no means necessary; that an undulating track, otherwise properly constructed, was not detrimental to successful operation. Mr. Sackett was re-elected president and J. B. Nelson vice-president. The next convention will be held in Indianapolis on January 13, 14 and 15, 1905.

DISSATISFIED TELEGRAPHERS.—It is stated that the 1,500 telegraphers employed by the Baltimore & Ohio Railroad have placed a demand with the company for shorter hours and an increase in wages. The main complaint is to the effect that the operators are kept at work in the towers longer hours than they are paid for.

INTERNATIONAL SUPPLIES.—The *World's Work* for February notes the fact that in the large power plant installed in the Mysore country in Southern India, the timber came from Australia, insulators from Italy, the hydraulic plant from Switzerland, the penstock pipes from Scotland, and the entire electric plant from America.

AN APOLOGETIC CORPORATION.—By way of making apology to the public for the bad trolley service in northeast New Jersey, the Public Service Corporation carried two columns of advertising matter in the columns of several of the local newspapers in the form of a statement signed by President Thomas N. McCarter. He admits that the service is bad, but says this is caused in part by changes necessary when the competing lines of North Jersey were merged, but more especially from the fact that the rolling stock acquired was in such a miserable condition that in the recent cold snap there was hardly a car that did not give out in some essential part after one or two trips. No relief is promised until spring, when open cars can be used and new cars being built will be delivered. After advising patience, the address concludes with a paragraph that has caused considerable adverse comment. It is as follows: "The Public Service Corporation has every disposition to comply with all reasonable demands of the public and regulations of municipal bodies. It cannot, however, thoroughly reorganize and largely re-equip an extensive street railroad system in a few months. Unreasonable and vexatious ordinances and impositions can only result in additional delay in the efforts of the company to improve its system, and will, of course, be contested if enacted. The strike of last summer followed by the flood and the severity of the present winter, have added considerably to the strain upon the facilities of this company to discharge its duties to the public. Besides, harsh and intemperate criticism tends to demoralize discipline and weaken the efficacy of the service."

ELECTRIC TRUCKS.—The following from the New York *Herald* looks like a partial or prejudiced statement: "After a thorough trial of self-propelled trucks for delivery work, several of the leading brewers of New York have decided to discontinue the service and replace with horse-drawn vehicles all automobiles now in use. Purchased primarily for advertising purposes, the electric brewery trucks have proved to be too expensive and unreliable to warrant their retention even for this purpose. One brewer who paid $4,500 apiece for eight of them about two years ago has offered, it is said, to throw off the $4,000 and take $500 around for the lot that he has on hand. Failing to find buyers for the second-hand motor trucks, he says, he will consign them to the scrap heap in preference to using them longer. The constant replacing of batteries, which cost about $750 each, and of tires, which cost $250 a set, makes the machines enormously expensive to maintain, and, notwithstanding the high cost of operating them, they are always breaking down on the road, preventing prompt deliveries and thereby hurting trade. Scarcely a day passes, it is said, without having to send out a pair of horses to drag one or more of the disabled motor trucks back to the repair shops. The brewer referred to announced when he purchased the first automobiles that he intended to use them altogether as soon as he could get rid of his horses and obtain enough machines to do the work. The shoe is now on the other foot. The machines having been tried and found wanting, he has decided to discard them altogether and use horses exclusively in the future. To this end he has just placed with Fiss, Doerr & Carroll a larger order than ever before for fancy draught horses of the brewery weight and quality to take the places of the discredited machines. Business houses that have experimented with the motor vehicles for light delivery work are in some instances no better satisfied than the brewers and are either discarding the costly toys outright or endeavoring to exchange them for horses and horse-drawn wagons. Fiss, Doerr & Carroll say they have been flooded with requests to take motor vehicles in part payment for horses, but, knowing of no way to dispose of the second-hand machines, have declined all such offers."

LETTER TO THE EDITORS.

Theories in Wireless Telegraphy.

To the Editors of Electrical World and Engineer:

SIRS:—Owing to absence in Europe my attention has only now been called to the letter of Mr. J. E. Taylor in your issue of December 26, and that of Prof. Blondel in the following issue. To discuss first M. Blondel's letter, I would say that the positions taken by M. Blondel and myself are really identical in regard to every single point discussed, and that where M. Blondel assumes a difference this is due to a misunderstanding. For example, M. Blondel states in his letter, paragraph 3, "If Prof. Fessenden has found this height very limited it is, I believe, simply because the energy decreases rapidly as the distance from the earth increases." Now there is no statement in any article or letter by me that I found the height very limited. As a matter of fact, as will be seen by a perusal of some of my articles, my method was to find the height at which the intensity decreases to 1/E th of the initial value. For example, in a previous article, I point out that waves 500 feet long penetrated about 8 inches into salt water, and about 2 feet into ordinary soil, before falling off to 1/E th of their intensity. That the height is, however, actually limited is true, as is shown by my measurements, and in this M. Blondel agrees with me for he states in his article, last two lines, "And present a maximum effect toward the horizon and *no* effect toward the zenith."

With reference to M. Blondel's statement that I have not taken account of the very great sensitiveness of the gold coherer, I would say that a reference to my article will show that I *have* done this, for in my article in these columns, October 31, page 728, I gave a table showing that the gold coherer is four times as sensitive as the regular coherer.

In addition, I would say that I was perfectly aware of the fact that the gold coherer can be made to have great sensitiveness, but as mentioned in my article, "In making this comparison the coherers were adjusted to be as sensitive as possible *without giving false signals,*" and an experience of five years in working with coherers of gold and silver and their alloys has shown me that when gold coherers are adjusted so as to be more than four times as sensitive as the ordinary coherer they become unreliable and are influenced by vibration, etc.

With reference to the question of syntonization by group frequency, I would point out that this is undoubtedly a case of simultaneous invention, as though M. Blondel's patent was filed May 3, 1900, mine was filed June 2, 1900, and the specification itself was actually drawn up in October or November, 1899.

The same would appear to be the case with reference to the method for the continuous production of waves, as though M. Blondel's patent was granted July 11, 1902, my patent was filed June 6, 1902, and granted August 12, while the experiments on which it is based were made more than a year earlier.

Personally, I would say that putting the commercial question to one side, it has given me considerable pleasure to find that my own ideas have been running concurrently with those of so eminent an electrician as M. Blondel, and this coincidence may possibly be taken as indicating that the theory of the subject rests upon a sound foundation.

The above will show, I believe, that the supposed points of difference between M. Blondel and myself do not exist and that our opinions are really identical. With reference to other points, I am happy to say that my measurements entirely corroborate the theory as given in his last paper by M. Blondel.

First, they prove absolutely that the energy falls off as the square of the distance, and hence that the waves are "Space propagated," i. e., they are spread over approximately spherical (hemispherical) surfaces, and not along a simple circular belt, which latter theory is held by Mr. Taylor. M. Blondel agrees with me, paragraph 3, in stating that Mr. Taylor is incorrect in attributing to the half waves a constant height. This was as I pointed out and is proved conclusively by my actual measurements of the height.

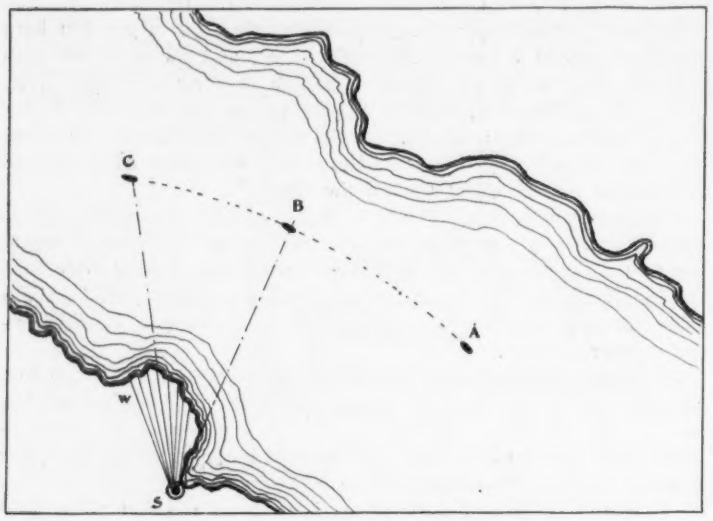
M. Blondel states that the energy decreases rapidly as the distance from the earth increases, as indicated by an energy curve which figures in his paper. This fact was, I believe, first indicated by me, and referred to in my article mentioned above, page 728, last paragraph from bottom, "The intensity was strongest near the ground

and diminished upwards, instead of the reverse, as would have been the case if the effect had been due to diffraction."

On re-reading M. Blondel's paper I see, however, that there is one point in which our ideas possibly do differ, *i. e.*, on the effect of the earth.

This question is rather complicated and I intend discussing it in a separate article. For the present I will give an actual practical illustration of its use which I think will indicate that there is something more required besides actually grounding the conductor. In the experiments above referred to a station was erected on the shore of an island at the point *S*, the island having roughly the shape shown in the accompanying figure. The island was formed of a mass of rock with slight patches of grass but without any soil upon it. The antennæ was grounded by a plate inserted in the water so that the resistance as actually measured between the antennæ and ground was only a few ohms.

A second set of apparatus was placed upon a tug boat having a 50-foot mast. When the tug boat was in the position *A* signals



WIRELESS TELEGRAPH EXPERIMENTS.

were received as far as the boat could go on the opposite side of the bay, *i. e.*, about 15 miles. On the tug boat passing around to the point *B*, while a message was being received on the boat the message was cut off in the middle of a word, absolutely, sharply and decisively, and communication was established equally as sharply on the boat reaching the same position when moving in the opposite direction. At all points beyond *B* in the direction of *C* it was impossible to obtain any communication. A wave chute was then laid over the surface of the island, consisting of a galvanized iron wire spread out in a fan shape and grounded in the water as shown at *W*.

As soon as this wave chute was constructed, communication was immediately established when the tug boat was in the position *C*, and on the tug boat moving off in that direction, a distance of 14 miles, the intensity appeared to be, if anything, stronger than in the direction *A*.

Bearing in mind, as mentioned, that the antennæ was grounded both before and after the construction of the wave chute, to a large plate of copper immersed in the sea and having a ground resistance of only a few ohms, it will be realized that *merely grounding the conductor is not the essential thing*. In fact, as M. Blondel has pointed out, the actual *metallic* grounding of the conductor is not necessary, as it may be grounded through a condenser. Of course, to insure any good results the condenser must have very large capacity, and merely terminating the lower end of the antennæ with a knob or Léyden jar is not sufficient, unless the outer coating of the Léyden jar is at the same time directly connected to earth. I am prepared to say positively that the real essential thing is not a metallic ground connection, but the existence of a natural or artificial wave chute.

It is quite possible that even in this there is no real difference of opinion between M. Blondel and myself, and that my statement as to the necessity of either a *natural* or artificial wave chute has been overlooked.

With reference to the sensitiveness of the liquid barretter, I am giving myself the pleasure of forwarding one of these receivers to M. Blondel, and I am convinced that he will find that I have understated rather than overstated its sensibility. From our last tests, this receiver appears capable of working a distance of 250 miles over land with the expenditure of one-quarter of a horse-power and verticals 140 feet high.

With reference to Mr. Taylor's communication, the whole point may be summarized by an extract from his letter of December 26: "How he (Prof. Fessenden) can possibly argue that the intensity can vary with the square of the distance on any 'sliding wave' theory under perfect conditions of transmission, is quite beyond me. When this is the case the waves are space propagated. That is, they are spread over a spherical or roughly spherical surface and not along a simple circular belt." In other words, Mr. Taylor still believes that the waves are propagated in the way he described them in his paper, *i. e.*, in an approximately circular belt, the waves being of constant height as is shown in the figure in his paper, reproduced in M. Blondel's article January 2, 1904, and he considers the idea that they are propagated in an approximately spherical surface as a *reductio ad absurdum*.

Now the mathematical theory of electricity as developed by M. Blondel and myself shows that these waves actually *are* propagated in the way he considers impossible, *i. e.*, are propagated in an approximately spherical (hemispherical on account of the presence of the earth's surface). In addition, actual quantitative measurements repeated again and again over a period of four or five years, in which all intensities were carefully plotted, show that the mathematical theory as developed by M. Blondel and myself is correct.

What has Mr. Taylor to present against the mathematical theory of M. Blondel and myself and my own quantitative measurements? Nothing but his own bare statements deduced from "logical considerations" and unsupported by the slightest particle of experimental evidence.

I think that any further discussion of Mr. Taylor's theory is unnecessary, until he produces some mathematical foundation for, or experimental confirmation of, his ideas. There are one or two statements, however, in Mr. Taylor's letter which I may touch upon. He states in his letter, second paragraph, that I have accused him of being a "lucky guesser." No such statement occurs in my communication. On the contrary, my communication shows, I believe conclusively, that Mr. Taylor is not a "lucky" but an "unlucky guesser," inasmuch as he assumes that the waves are propagated in an entirely different manner from what theory and experiment shows to be the fact.

He states that I have assumed that he made no experiments. I made no such statement. The assumption I did make was that he had made no *quantitative* measurements. If Mr. Taylor has made any quantitative measurements, he has done himself an injustice in concealing the fact. So far as I know, at the present time there is only one form of receiver in existence which is capable of giving accurate quantitative measurements, and that is the hot-wire barretter. If Mr. Taylor knows of any other piece of apparatus, he should certainly disclose it.

With reference to Mr. Taylor's statements that the curvature of the earth would have little or no effect on transmission, I would say that this is incorrect, as it can be mathematically demonstrated that a wave transmitted from England to the antipodes will lose exactly 50 per cent. in intensity. Mr. McDonald has, I believe, made two calculations on the loss across the Atlantic, and I understand gets somewhat different results from the above, but I believe that my results will be found correct.

With reference to Mr. Taylor's statement, "Ionized air would and does absorb much of the energy from the waves, according to the degree of ionization present," I would say that this is another instance of the inadvisability of attempting to apply "logic" instead of quantitative measurements to natural phenomena. I have a set of accurate quantitative measurements extending over half a year, including thunder storms, droughts, zero and freezing weather, snow storms, rain and fog, and I am prepared to say now that up to date there is no evidence of any such ionization effect. I do not mean that no change in intensity has been observed, but that in every case where change in intensity has been observed it has been found to be *mainly* due to other causes, one being the type of receiver used. I would point out that up to the present time absolutely no evidence has been given that, even if this effect does exist to the extent mentioned, it is due to the effect of ironized air and not to other causes.

With reference to Mr. Taylor's definition of waves, that in all

waves the electrical and magnetic energies are equal, I would refer him to Dr. Pupin's paper in the *Transactions* of the American Institute of Electrical Engineers, February, 1901, entitled "Wave Transmission over Cables and Long Lines." I am prepared to believe that Dr. Pupin's definition of a wave is as permissible as that given by Mr. Taylor.

With reference to the question of the phase of the energy in Lodge's waves, I would point out that since the term Lodge waves was introduced by me and defined in the manner stated, any wave which does not have this property cannot be called a Lodge wave.

As regards correctness of this definition Prof. Lodge's own statements may be quoted. For example, on page 5 of his work entitled "Signalling Through Space Without Wires," Third Edition, Sir Oliver Lodge says: "Furthermore, any conductor electrically charged or discharged with sufficient suddenness must emit electrical waves into the ether, because the charge given to it will not settle down instantly, but will surge to and fro several times first; and those surgings or electric oscillations must, according to Maxwell, start waves in the other, because at the end of each half swing they cause electromagnetic effects, and the rapid alternation from one of these modes of energy to the other constitutes etherial waves. If a wire is handy they will run along it, and may be felt a long way off.

"Strictly speaking, in the waves themselves there is no lag or difference of phase between the electric and the magnetic vibrations; the difference exists in emitter or absorber, but not in the transmitting medium. True radiation of energy does not begin till about a quarter wave length from the source and within that distance the initial quarter period difference of phase is obliterated."

In the conductor, therefore, the energy alternates between the electrostatic and the electromagnetic. We know from the mathematical theory of electricity as set forth, for example, by Prof. J. J. Thomson in his "Recent Developments," and also from direct experiments made by myself and others, that if we have a long straight vertical antennæ, the wave length produced by its discharge will be four times the height. In other words, that the disturbance will approximate the velocity of light.

Waves of the type imagined by Mr. Taylor, having a constant height and spreading out in a "circular belt," have no existence and are at variance with the mathematical theory of electricity.

It was on waves of this character, oscillating backward and forward in conductors, that Sir Oliver Lodge made his brilliant investigations.

We have, therefore, three separate and distinct classes of waves, differing fundamentally from one another.

First. The waves investigated by Hertz. These travel in straight lines, and their electromagnetic and electrostatic energies are a maximum at the same instant.

Second. The waves investigated by Lodge. These differ from Hertzian waves in that they do not travel in straight lines, but follow the conductor. They also differ in that, as pointed out by Lodge (Ibid.), the electrostatic energy is a maximum at the time when the electromagnetic energy is a minimum.

Third. The waves investigated by me. These differ from Hertzian waves in that they do not travel in straight lines, but are guided by the surface of the conductor. They differ from Lodge waves in that the electrostatic and electromagnetic energies are a maximum at the same instant.

All these waves travel with approximately the velocity of light, and have their electromagnetic and electrostatic eneergies equal.

It is hoped that the above brief definition of the three broad classes of electromagnetic waves which have up to date been investigated will prove useful in distinguishing between the different types.

A fourth kind of wave observed in some of our experiments may be described as a closed or anchor ring wave. I hope to describe this at some time in the future.

With reference to Mr. Taylor's assumption that my barretter was incapable of detecting currents in the earth, I would point out that in the first place this is pure assumption, unsupported by any evidence, and secondly, that if Mr. Taylor had read Mr. Collins' paper carefully he would have found that as a matter of fact currents *were* observed in the earth. For example, in the fifth paragraph of Mr. Collins' paper he states that "At the point where the direction of the waves changed from along the water to up the slope of the bank currents were generated." Now, in going up the slope of the bank, the detector was shunting a circular belt of the earth's surface in exactly the same way as when the ground was horizontal. Therefore, the statement that the detector was not sensitive enough to show currents when shunting a circular belt of the earth is incorrect, since currents in the earth were actually observed and quantitatively measured.

In addition to the actual fact that currents were actually measured under these conditions, I would point out that if Mr. Taylor will calculate the resistance of the earth he will find that not only was the detector, which responds to 1/50 of an erg, sufficiently sensitive, but also that in practice it is necessary to shunt the hot-wire barretter with a metallic conductor in order to prevent its being destroyed. This matter I will discuss in a separate article, as my statement is to a certain extent conditioned by what is meant by a "current." An effect was produced on this barretter in all cases.

I note that Mr. Taylor states that his measurements on the relative sensitiveness of coherers and magnetic receivers do not agree with mine, and that he finds that there is "a surprising small difference between them."

I might point out that Mr. Taylor has not indicated, as I have done, the method in which he made these measurements, but it will suffice if I quote the following from experiments made by the Marconi engineers, and published in the *Scientific American* on November 28, about a month after my paper appeared:

"The result was that, under such conditions, over a distance of 76 km (47 miles), which is that from San Vito to Leghorn, the Morse apparatus required a 9 mm. (.354-in.) spark in order to receive properly, while with the magnetic detector, receiving was possible and satisfactory with sparks of but 2 mm. (.078 in.)."

Since the energy varies approximately as the square of the spark length, it will be seen that the magnetic hysteresis receiver was approximately 25 times as sensitive as the coherer.

Now, my measurements, given in my letter of October 31, made it about 40 times as sensitive, and in this connection it may be mentioned that I have been informed that the Marconi engineers have not yet been able to design a transformer so as to obtain the best results with the magnetic receiver, while I have.

The fact that the Marconi engineers found that the magnetic receiver is 25 times as sensitive as the coherer and I find it 40 times as sensitive, while Mr. Taylor finds "a surprising small difference," may be taken as an indication of the relative reliability of Mr. Taylor's measurements and those made by us.

It must not be inferred from what I have said above that I have failed to recognize the admirable work done by Mr. Taylor in wireless telegraphy. No one appreciates the value of his labors more than I. But engineers in general do not, I believe, understand the present status of wireless telegraphy, and the fact that it is now upon a strictly quantitative basis. The design of a wireless telegraph plant is now just as much a matter of strict calculation as a design of a dynamo, and in fact it is possible to design a wireless telegraph plant much more accurately than one can design a wire line.

Electrical engineers in general would probably be astonished to know that it would be possible at the present time to fill three or four volumes of the size of S. P. Thompson's "Dynamo Machinery" with nothing but a discussion of the principles governing the design of wireless stations and apparatus. Some day I hope to be able to take up this question, but the amount of labor involved in merely transcribing the results is enormous. The experiments alone are numbered by tens of thousands, and a large safety deposit compartment in Pittsburg is at present occupied by record books filled from brim to brim with the quantitative and qualitative measurements which have been necessary for developing this line of work.

Aside entirely from the question of the point above discussed, is the broad one of whether these waves are a new form of wave. It is true that, as Mr. Taylor points out, in my paper before the American Institute of Electrical Engineers I attribute the broad theory to Heaviside, because, as a matter of course, since these are a particular type of electromagnetic waves, their theory must be a particular case of the general electromagnetic theory. Consider, however, the case of the Hertz waves. The theory of these waves was given by Maxwell. The means of producing these waves was given by Fitzgerald. Maxwell's theory and Fitzgerald's method have been shown to be absolutely correct. Hertz was the first to invent a receiver which would be capable of measuring them, and he was the first to *actually make* such measurements. So far as I am aware nobody has, up to date, found fault with Hertz for describing these waves as a new type. My own case is exactly analogous. The general theory of these waves has been given by Heaviside, the idea of images has been suggested by Delaricci and Blondel. The method of generation was to a certain extent known. I was the first to devise a type of receiver capable of quantitatively measuring these waves and also the

first to plot their shape and show the way in which they were propagated.

Until this was done there was no certainty as to the nature of these waves, as is shown, for example, by the fact that Mr. Taylor is still of the opinion that the energy does not fall off as the square of the distance.

I believe, therefore, that I am justified in calling these waves a new type of wave, because they are a new type of wave in exactly the same sense that Hertz waves were a new form of wave at the time that Hertz investigated them.

I would here correct a typographical error in my letter of November 13 on the "Relative Reliability of Wireless and Wire Telegraph Systems." As originally written the statement was made: "A number of interfering stations both in New York and Philadelphia." In setting up the article the compositor substituted for the words "A number" the figures giving the height of the verticals at the stations, and made the article read "There are 135 interfering stations." Though the mistake is, of course, self-evident, I take the opportunity to mention the fact that during the yacht races there were sometimes as many as 12 stations simultaneously operating in the vicinity of New York.

WASHINGTON, D. C. REGINALD A. FESSENDEN.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-Phase Commutator Motors.—OSNOS.—The first part of a long article in which he gives a review of the development and method of working of single-phase commutator motors. He says that to Lamme is due the credit of having brought single-phase traction successfully before the public and for having shown that the single-phase commutator motor can be successfully used in practice. The Lamme motor does not represent a novel type of alternating-current motor, but an important improvement in the design of the old series motor. To Thomson is due the invention of the repulsion motor. The author then calls attention to the work of Atkinson, who invented from 1895 to 1898 several commutator motors and had recognized at that time the possibility of regulating the speed in this wide limits without an essential loss of energy. The author then gives a critical and comparative analysis of the various types of commutator motors which have been invented. In each case a diagram is given, together with a reference to the first description of this type and a statement whether this type is patented in Germany or not. He first deals with the series motor in original form, which involves difficulties, first in so far as the oscillating exciting field induces an e.m.f. in the coils which are short-circuited through the brushes, and second, on account of the phase difference. The e.m.f. of commutation is not greater than with direct-current motors. Since the e.m.f. induced by the alternating field in the short-circuited coils is proportional to the number of turns, a decrease of the number of turns per segment also diminishes the short-circuited currents which are due to this alternating field. The phase difference of the series motor is due to the self-induction of the stator and of the armature. The latter can be compensated for by the use of a compensating winding, either in series with the armature (Steinmetz) or short-circuited on itself (Heubach). The shunt motor does not seem to be promising since its power is in general very small. He then discusses various forms of repulsion motors and points out that the frame of the repulsion motor should be formed of uniformly distributed iron masses. For the stator winding a uniformly distributed winding is preferable. In comparing the repulsion motor and the series motor he says that the former has a greater phase difference for the same weight. On the other hand, the repulsion motor has the good quality that the commutator is always short-circuited and has not to transmit any electric energy, so that the commutation will be in this case just as easy as with slip rings. The author then discusses various types of the repulsion motor invented by Atkinson, and shows how some other combinations may be derived from the same. The article is to be concluded.—*Elek. Zeit.*, Jan. 7.

Single-Phase Motors.—LATOUR.—His reply to Eichberg's communication, recently noticed in the Digest, on the priority of invention of the Eichberg-Wintner single-phase traction motor. The claims that Wintner and Eichberg, in their German patent specification, first proposed to return the energy usually dissipated in the rotor circuits of polyphase motors (external resistances) to the supply network, by the use of a commutator on the rotor and a recuperating transformer with a variable ratio of transformation. To obtain the same results in single-phase motors, they adopted the following arrangement: In Fig. 1 the stator is connected by the main terminals *e f* to the single-phase network *AB*, the instantaneous voltage of which is $V \sin wt$. The brushes *c d*, placed in line with terminals *e f*, are connected to the recuperating transformer *T*, the transformation ratio of which is varied with the speed of the rotor. The rotor torque is obtained by connecting the auxiliary stator terminals *a b*, placed at 90 degrees to the main terminals, *e f*, to an auxiliary source of current, the voltage of which is in quadrature with the voltage of *AB*. Because Wintner and Eichberg have stated that, as an alternative, the auxiliary source of current may be applied to the rotor by brushes, *a' b'*, placed in line

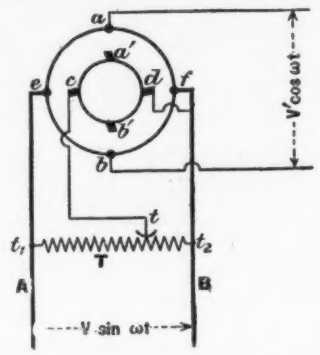


FIG. 1.—SINGLE-PHASE MOTOR CIRCUITS.

with *a b*, the present writer claims that they have failed to understand the essential phenomena of compensation. This argument is that if at, or nearly at, synchronous speed of rotor the brushes *c d* are short-circuited by bringing the contact *t* to the terminal t_2 of the recuperating transformer *T*, while the brushes *a b* are connected to the auxiliary source, the rotor and the stator windings will be burned out and the torque of the motor will completely disappear. This will take place owing to the suppression of self-induction in the rotor. The writer claims that since Winter and Eichberg have become acquainted with his compensated motor they have modified their original ideas and now point out the advantage of zero-phase displacement between the instantaneous voltages of the network *AB* and the auxiliary source.—Lond. *Elec.*, Jan. 8.

REFERENCES.

Electric Motors.—HOBART.—A continuation of his long serial on electric motors, their theory and construction. The present installment deals with the slip and torque of induction motors. Only elementary mathematics is used, but the explanation is very specific, the author giving much numerical data. A table of diagrams gives data of various induction motors.—*Traction and Transmission*, January.

Eddy-Current Losses in Machines.—See the abstract on Eddy Currents under Electrophysics.

Lights and Lighting.

REFERENCE.

Train Lighting.—MARTENS.—The conclusion of his illustrated serial on different methods of electric train lighting. The present insallment gives an illustrated description of a system devised by Kull and employed by Brown, Boveri & Company, in which use is made of a shunt dynamo of special construction, a small storage battery and

various controlling apparatus. The system of Vicarino is also described.—*Dingler's Polytechn. Journal,* January 9.

POWER.

Pumping Station.—A fully illustrated article on Philadelphia's new fire-fighting service, covering the congested business portion. There is provided a central pumping station and independent pipe system whereby high pressures are obtained directly at the hydrants. The pumping station will contain ten pumps each capable of delivering 1,200 gallons per minute at 40 revolutions, against a pressure of 300 lbs. per sq. in. There are also two pumps of 350 gallons capacity per minute. Each of the large pumps will be driven by a 280-hp, three-cylinder, single-acting gas engine, and the small pumps by gas engines of 125-hp each, which will also drive ignition generators of 7.5-kw each and the air compressors supplying air at 200 lbs. pressure for starting the main engines. There are three sources of current for ignition, connections with the city lighting mains and a storage battery being provided in addition to the ignition generators. The lighting current is reduced from 220 to 110 volts by a rotary converter. The engines are started with compressed air in one cylinder with the relief valves on the pumps open. These valves are controlled by electric motors operated from the engine platform, one motor being on each valve. The entire work of operating the engines, pumps and valves is under the immediate control of one person, who, from the gallery of the engine, without moving from his position, can open and close all valves by means of electric devices.—*Iron Age,* January 21.

Power Absorbed in Drilling.—NORRIS.—An account of an extended investigation of the power absorbed in drilling in various metals at various speeds and feeds. The results are given in tables and the following general conclusions are arrived at: When the speed and feed are constant, the power required to drill cast steel is about 1.10 times, wrought iron about 1.65 times and machinery steel about 1.90 times, that required to drill cast iron. When the speeds and feeds remain constant, the power required is approximately proportionate to the diameter of the drill. When the diameter of the drill and rate of feed are constant, the power required is approximately proportional to the speed. When the speed and diameter of drill are constant, the power required is approximately proportional to the feed.—*Am. Mach.,* January 14. The numerical data given by the author are represented in form of five diagrams in *Am. Mach.,* January 21.

REFERENCES.

Milling Machine.—A detailed illustrated description of a universal milling machine of the Brown & Sharpe Manufacturing Company, an essential point of which is that the power-receiving shaft runs at a constant speed and variations of the spindle speed are obtained by means of change gearing. Thus the machine, when motor-driven, enables the use of a constant-speed motor.—*Iron Age,* January 14.

Turbine Tests.—An account of tests of turbines for the Cleveland, Elyria & Western Railway. These turbines are of 1,000 kw, direct-connected to a two-pole, three-phase alternator of 50 cycles. The turbine ran at about 1,500 r.p.m. and had an average overload of 50 per cent. Data from the test are given.—*St. R'y Jour.,* December 19.

Turbo-generators versus Reciprocating Engines.—See the abstract on Eddy Currents under Electrophysics.

TRACTION.

Alternating-Current Traction.—An abstract of the discussion at the Manchester local section of the (British) Institute of Electrical Engineers on Eborall's paper recently abstracted in the Digest. Portheim read extracts from a letter from Blathy (of Ganz & Co.), comparing three-phase and single-phase motors for economy and efficiency, to the advantage of three-phase. The losses are greater in single-phase, more expensive gear is required for regulation, and they are restricted to a low-pressure system. Regulation with three-phase is effected by the half-speed cascade arrangement. The capital outlay for three-phase and single-phase is the same. He considers it no disadvantage that three-phase motors have to take the worst grades at full speed, and the sub-stations ought to stand the overload. To obtain the same acceleration the cost of three-phase is only equal to direct-current equipment. Regeneration of three-phase on the down grades is an advantage. He remembered making arrangements to supply three-phase traction current to a colliery and when the line came to be operated, with empty trains going up and full ones coming down from the colliery, they found that instead of supplying current to the colliery they were furnishing current to the supply company. Comparing the double trolley with the single, he drew attention to the fact that the same power can be transmitted through the double trolley at a lower voltage, and, any way, the cost of the line can be only 7 per cent. of the cost of the locomotive equipment. He believes it is only 1½ per cent. on the Valtellina Railway. The three-phase motor is as simple as any other motor, and in heavy main-line work the pressure would have to be greater for single-phase than for the two-wire, three-phase line. Rhodes expressed his disbelief in single-phase motors with commutators. The great point about alternating-current motors would have to be the absence of a commutator and freedom from repairs to minor details. Eborall said that there was no hope for single-phase motors starting with phase-splitting arrangements beyond ordinary industrial application. He defended commutators in low-frequency, single-phase motors, but said that in any case a series motor is hopeless over 25 cycles.—Lond. *Elec.,* January 1.

Alternating-Current Traction.—Some editorial notes on Arnold's electropneumatic system. Its success is thought to depend upon the controlling valve mechanism for securing the proper relative action of the electric and compressed air devices. Assuming that this arrangement is perfectly successful—that is, that by its means the air engines geared to the motor may be made to equalize the varying load, torque and speed requirements at all times, without sacrifice of reliability or material drop of efficiency—then the system is believed to promise the best combination of the advantages of the direct-current system and high-tension alternating-current transmission that has yet been proposed. The weight of car equipment is rather high, but applied to a locomotive it will not be a disadvantage. Concerning the use of high voltage it is doubtful whether the public and the responsible authorities will permit high-voltage trolley lines to be installed, if at all, without better guarantee of safety than is afforded by present practice in car wiring and operation. The same contains a communication by Lincoln in which he replies to some criticisms in a former issue on his paper on alternating-current traction. Concerning the use of high voltage he says that practically all of the apparatus on the car may be placed in the low-tension side of the car transformer. The only high tension on the car, therefore, consists of the high-tension winding of the transformer, the current from the trolley to the transformer and a circuit-breaker. These can be protected so as to make the escape of current practically impossible. The part of the apparatus from which the current is most liable to escape, namely, the motors and controlling apparatus, are at voltages which are lower than present direct-current practices. It is a question, therefore, whether or not the alternating-current equipment is not really safer than the present direct-current equipment. Moreover, the trolley voltage can be reduced at will by increasing the number of transformers along the line. The cost of this would not be prohibitive.—*Eng. News,* January 7.

Three-Wire System for Traction.—MCMAHON.—A long paper read before the (British) Inst. Elec. Eng. on the City & South London Railway, in which he gives the working results of the three-wire system used on this road. Fig. 2 shows the system in its simplest form; that is, all the independent cables for supplying the lifts and lighting circuits being omitted for the sake of clearness. The up and down working conductors, with the running rails as the middle wire, form the three-wire system pure and simple, the 500-volt generators being on either side of the system. To supply the sub-station, another generator, either steam or motor-driven, adds an additional 500 volts to an additional set of high-tension bus-bars, from which the two sub-stations are fed at 1,000 volts above the rail potential, or 2,000 volts across the outers. The pressure is reduced at the sub-station by special reducers, in which only half the energy is transformed and the cable drop compensated for. In the engine house at Stockwell seven direct-connected sets are installed varying in output from 125 kw to 800 kw. The author gives details of an all-day test, discusses electric versus hydraulic lifts in favor of the former, and gives detailed accounts of results obtained in continuous working. The coal per ton-mile at the switchboard amounts to 0.237 pounds, which figure includes all boiler house losses, such as lighting up boilers, etc. If compared with main line locomotives the result is in favor of the latter, but the author calls attention to the fact that the energy spent upon accelerating main line trains is only a fraction of that spent upon a line of short sections, and the traction resistance per ton is at least double that obtained in main line practice. "The published re-

sults obtained with steam locomotives are usually taken over short periods and refer to special tests from which all standing losses are excluded. When the time arrives at which electric locomotives can be tried under conditions similar to those of steam locomotives, there is every reason to believe that the coal per ton-mile will be in favor of the electric locomotive." The latest type of powerful locomotives used on this road has been very successful, and it has been found that the slot-wound armature is vastly more satisfactory than the smooth-core armature. In an editorial discussion of the paper special attention is called to the following points: Using direct-current generation with only 2,000 volts maximum pressure (1,000 volts either side from earth), the Angel sub-station, at a distance of 5½ miles, delivers 83 per cent. of the power delivered at the bus-bars. The result is not materially different from the all-day efficiency of a three-

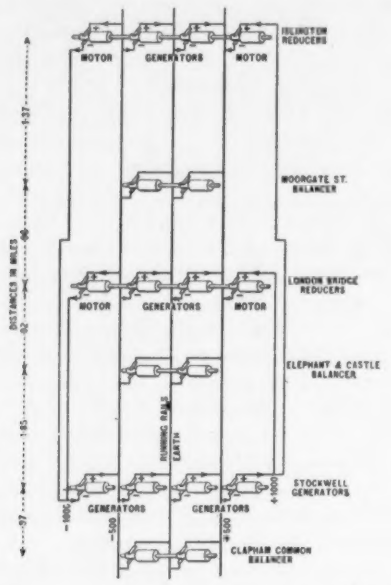


FIG. 2.—THREE-WIRE TRACTION SYSTEM.

phase rotary converter working on a similar load factor, but is attained with a lower working pressure and very much less expensive converting apparatus. The main reason for this is that the current has not to be transformed in kind, consequently the high-tension mains and the transforming apparatus have to deal only with a portion of the current, and transformation losses are incurred upon that portion only. The total result over the whole line is that from generating station switchboard to locomotive, the net efficiency is 90 per cent. This figure is decidedly higher than the all-day efficiency of a rotary converter on a traction road, and the capital expenditure is obviously on the side of the direct current. For such lines as that of the City & South London Railway, a direct-current generating station has an economical radius of at least 6 or 7 miles.—Lond. *Elec.*, December 18, 25.

Electric Traction on Canals.—An illustrated description of the system used in the trials of electric traction on the Teltow Canal in Germany. For most part a locomotive running on the tow path is used, while at special points a vessel provided with a storage battery of 220 cells is used for dragging the boats through the canal. This vessel can also get current from a double overhead wire, either by contact rods of 12 m. length of the kind used for tramways without rails or the Lombard-Gerin system may be used, in which a small motor runs along the trolley wire and is connected with the wires supplying the current to the vessel. For the locomotive also two overhead wires are used, because the return of the current through the rails would have disturbed the magnetic observatory in Potsdam. Otherwise a single trolley would have been sufficient. Some details are given of mechanical arrangements of the locomotive. In a test in which four vessels, representing an aggregate load of 1,450 tons, were dragged with an average speed of 4.35 km. per hour, the tractive force was 2,000 kg. during starting and otherwise, 1,000 kg. in the average. The voltage between the two overhead wires was 445 volts and the average current consumed was 35 amp. The average efficiency was 61.5 per cent. The electric boat is provided with three screws, each being driven by a 20-hp motor running at 600 r.p.m. normal speed. If current is supplied from overhead wires a voltage of 500 to 600 volts is used. If storage batteries are used the voltage impressed on the motors is 400 to 450. For regulating the speed within wide limits the connections of the motors are changed, eight different arrangements being possible. In a test in which the boat had no trailer boats, the speed was 12.5 km. per hour and the current consumed was 85 amp. at 400 volts. If the boat drags two vessels with a total weight of 454 tons, it attains a speed of 5.2 kw per hour and consumes 43 kw. This shows that the efficiency of the boat is not nearly so high as that of the locomotive. The main reason is that the efficiency of a ship's screw with a small diameter is very low. Since only for short stretches of the canal the electric vessel is used, and the locomotive on by far the greatest part, the low efficiency of the electric vessel has only a small influence on the economy of the whole service.—*Elek. Zeit.*, December 31.

REFERENCES.

Running Trolley Wire.—HARVEY.—Since a properly constructed wagon for carrying trolley wire drums and running out the wire is sometimes too expensive in smaller cities, the author has devised a cheap reel frame for this purpose which can be placed and worked on the top of an ordinary two-wheel stiff cart and has most of the advantages of a proper reel wagon. The apparatus is described together with drawings.—Lond. *Elec. Rev.*, January 8.

Insulation of Trolley Wire.—MOERK.—A brief mathematical article illustrated by diagrams in which the author gives an account of insulation measurements of the trolley wire with electric tramways.—*Elek. Zeit.*, January 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Cut-Outs.—ANDREWS.—A communication referring to the opinions expressed by various other writers in a discussion on this subject, as was recently noticed in the Digest. The present writer has for 10 years experimented on a great many different types of cut-outs and has reached the following general conclusions: Zero cut-outs are useless. Maximum cut-outs in generator circuits are equally useless. Polarized cut-outs will work satisfactorily on a small or moderate reverse current, but will almost invariably fail on a short circuit, because the heavy series current entirely wipes out the effect of the permanent magnets. The releasing pull of a reverse-current cut-out should increase as the reverse current increases, as it does in an excess current cut-out. This result can only be obtained by employing the series current to directly operate the cut-out. In many types of cut-outs the release pull increases with the reverse current up to a certain point. The curve then doubles back and, with a further increase of current, falls to a zero and reverses to a holding-in pull, thus causing the cut-out to fail. Compound-wound devices will fail if the e.m.f. winding is coupled directly across the terminals of the generator controlled, as a short across the brushes will cause this e.m.f. to fall to zero. If the shunt winding of the cut-out is connected across a battery in parallel with the generator, the resistance of the battery and generator leads will often serve to maintain sufficient e.m.f. across the shunt to operate the cut-out. This, however, cannot be relied upon. To obtain absolute reliability the shunt windings of the cut-outs should be excited off a small independent battery, that will be unaffected by any disturbance on the supply system. Reverse-current cut-outs should not operate with a reverse current of less than 25 per cent. of the full-load current. Cut-outs can quite well be made to operate on a reverse current of less than 5 per cent. of the full-load current, but such cut-outs require fine adjustments and are more liable to give trouble.—Lond. *Elec.*, January 8.

Graphite Rheostat.—KLEIN.—An illustrated communication referring to the graphite rheostat of Hopfelt mentioned in the Digest October 31. He also has found that graphite powder has special advantages for use in rheostats since the resistance of such powder decreases gradually while current passes through it. This property seems to make such a rheostat suitable for starting motors. However, such a rheostat changes with the time, having a different initial resistance when freshly filled than after having been used for some time. After such a resistance has been used for a while its resistance when current begins to flow is much smaller than when it is freshly filled, so that the valuable property of a considerable decrease of resistance while the current passes is finally lost. This is due to the fact that the powdered graphite has conglomerated into globules, which are better conductors than the powder.—*Elek. Zeit.*, November 26.

HOPFELT.—A reply to Klein. He confirms the observations of the latter, but has found that the conglomeration in globules is due to impurities which are either in the graphite powder or are due to evaporation of the insulating layers and the contact plates with the rheostat. For this reason he now uses specially prepared pure graphite

and provides for good radiation of the heat developed in the rheostat. A freshly-filled graphite powder rheostat changes with the time, although unused, slightly compressed powders decreasing in resistance and strongly compressed powders increasing. It is, therefore, necessary to choose such a pressure that there is no change of resistance with the time. He states that several hundred of these rheostats have been used for months and some for a year and a half and none of them has shown a change of resistance.—*Elek. Zeit.*, December 31.

WIRES, WIRING AND CONDUITS.

Perforation Voltage.—BAUR.—An article in which the author gives the results of experimental investigations which confirm the imperical law given by him before. It states that the voltage at which a dielectric is perforated equals a constant multiplied by the ⅔ power of the thickness of the dielectric plate in millimeters. The constant, therefore, represents the e.m.f. in volts which is required to perforate one millimeter of the substance. It is, however, not entirely constant, since it slightly increases with increasing thickness of the dielectric. For air with a sinusoidal current and plate electrodes the constant is about 3,000 volts, while for air with sinusoidal current and needle point electrodes the constant is 2,400 volts. Pointed electrodes, therefore, require a smaller perforation voltage than plate electrodes, as has long been known. He uses this formula to determine the voltage of a lightning flash. If the length of air perforated by the lightning flash is one kilometer, then the voltage is 30,000,000, if the constant is 3,000; but since the constant is greater for a greater distance, the voltage of the flash is estimated as about 40,000,000. For mica the constant is 58,000, for paraffine 20,000.—*Elek. Zeit.*, January 7.

Power Transmission Cables.—SCHMIDT.—A continuation of his illustrated serial on the construction and manufacture of cables. In the present installment some details are given on the construction of cables of Cassirer. Impregnated paper and jute is used either alone or combined. For the high-tension cables with fibre insulation, paper is used, although on the basis of good results in practice, paper is already used in cables with 500-volt pressure. The cables insulated with paper or jute are mainly used for underground power transmission, while the lead-covered cables, insulated with vulcanized rubber, are mostly used in mines and on shipboard. Some details are given as to cables between 250 and 2,000 volts.—*Elek. Anz.*, January 3.

ELECTRO-PHYSICS AND MAGNETISM.

Eddy Currents.—THORNTON.—The conclusion of his illustrated paper. He discusses the influence of periodic irregularity of armature rotation and of unequal turning moment in prime-movers on the magnitude of the eddy currents, and gives the results of some experiments made by him which show that the efficiency of a transmission system supplied from turbo-generators may be several per cent. higher than from reciprocating engines. Two con-

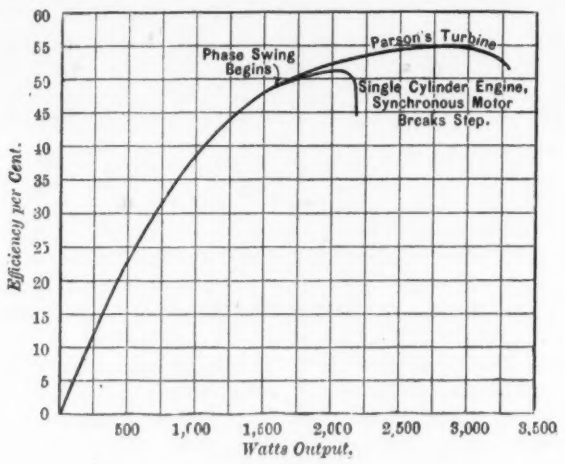


FIG. 3.—CURVES OF TESTS.

verters in his laboratory were connected single-phase, then driven by direct current, first from a turbo-generator and afterwards from a single-cylinder, double-acting engine with a heavy fly-wheel. Measuring the input and output by carefully calibrated wattmeters, the curves shown in Fig. 3 were determined. The author remarks that the case no doubt represents the two extremes of engine regularity, "but many large gas engine plants show much more fluctuation on load than does a 75-hp, single-cylinder engine." In an appendix the author deals with the separation of eddy current and hysteresis loss in armatures.—Lond. *Elec.*, January 8.

Damping of Oscillations.—KOWALSKI.—An abstract of a paper read before the French Society for the Advancement of Science, in which he discusses the reasons of the disagreement between the theoretical formula of Lord Kelvin for the damping of electric oscillations and the experimental results of various physicists. He finds that Kelvin's formula is correct and that the disagreement formerly found is due to the fact that the theoretical conditions of the experiments were not rigorously maintained. Poor insulation of the self-induction coils is the main fault. In fact, the measurement of the damping which can be made with great accuracy, may be used as a good indication of the quality of the insulation. He emphasizes the importance of good insulation for the various applications of electric oscillations.—*L'Eclairage Elec.*, December 12.

REFERENCES.

Dielectric Hysteresis.—BEAULARD.—A paper read before the French Association for the Advancement of Sciences. Schaufelberger has formerly indicated a method for studying dielectric hysteresis, but an error in the calculations has rendered his numerical values inexact. The present author has recalculated the results of these experiments. One of the interesting results at which he arrives is that of the two hypotheses on ether—one assuming the ether at rest and the other assuming the ether to be carried together with moving matter—the latter is the more probable one. It is the fundamental hypothesis of the theory of the electrodynamics of Hertz.—*L'Eclairage Elec.*, December 12.

Quaternions in Electrical Calculations.—FERGUSON.—A brief paper on the use of quaternions in the theory of alternating-current phenomena.—*Phys. Rev.*, November.

Terrestrial Magnetism.—MATHIAS.—An abstract of a paper read before the French Association for the Advancement of Science on the law of regular distribution of the total force of terrestrial magnetism in France on January 1, 1896.—*L'Eclairage Elec.*, December 12.

Nature of Radioactivity.—LODGE.—An abstract of a lecture in which he considers that the phenomenon of radioactivity is intelligible and simple on the theory that it is due to atomic disintegration. The important consequences of the theory are the belief in the mutability of matter and the transmutation of the elements.—Lond. *Elec.*, January 8.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrical Losses in an Electrolytic Copper Refinery.—HUTCHINSON.—An account of the results obtained in the course of an investigation made in 1897 on the cost of producing and using steam power throughout the Anaconda works, and also of determining the cost of electrolytic refining at these works. The energy loss in contacts in the tanks, obviously great, was considered in detail. For one "system," comprising 200 tanks in series, the current was 3,800 amp., the pressure at the generator 67 volts; the losses in switchboard, 0.31 volt; in feeders, 2.00 volts; in mains, 6.00 volts; in all contacts, 7.36 volts; hence, the total volts lost, 15.67, i. e., 23.5 per cent. Thus the electrical efficiency from generator terminals to the solutions was 76.5 per cent. and the total loss from generator to solution was divided as follows: In switchboards, 2.0 per cent.; in feeders, 12.8 per cent.; in mains, 38.4 per cent.; in contacts, 46.8 per cent. For one tank system of 200 tanks the loss thus amounts to 60 kw; this makes the total annual cost of wasted energy for one tank system $9,400, and for six, $56,400. As the capacity of the refinery was approximately 30,000 tons per year, this gives a cost of $1.88 per ton for lost energy. While this amount seems small, it is very approximately equal to the interest on the total investment in the refinery plant; hence, a saving of one-half of this loss would justify an increase of 50 per cent. in the total investment. "As a matter of fact, one-half of this loss can be saved for a very much smaller sum." The author thinks that the fondness of refinery managers for secrecy is absurd, "since there is nothing to conceal," and that undue secrecy and refusal to compare results with others leads to poor results.—*Electrochem. Ind.*, January.

REFERENCES.

Edison Accumulator.—BAINVILLE.—An article criticising some claims made by Hibbert and relating to his tests of the Edison accumulator. He objects to Hibbert's claim that the property of the

Edison accumulator to stand a heavy rate of discharge, although already half discharged, is a characteristic feature of the cell for traction purposes. He claims that a lead accumulator in good condition is equally capable of fulfilling the requirements of electric traction. As the essential features of the Edison battery, he considers its great durability and its rapid recovery of the original e.m.f. after discharges at a high rate. He does not believe, however, that the latter property is as important as it is claimed to be.—*L'Elec.*, January 2.

Electric Discharges Through Gases.—Kowalski.—An abstract of a paper read before the French Association for the Advancement of Science. He describes his experiments on chemical action of high-frequency discharges through mixtures of gases. At a certain frequency the discharge obtains a special character, which depends upon the quantity of electrical energy. He has especially investigated the production of nitrous vapors by means of discharges through air, and the subsequent production of nitric acid. He states that it is possible to get up to 44 grams of nitric acid per kw-hour, and that the price of the kilogram of calcium nitrate would not be more than 13 centimes (about 2½ cents).—*L'Eclairage Elec.*, December 12.

Rare Elements.—Lenher.—The first part of a summary of our present knowledge of what are called the rare elements. The present installment deals with the radioactive elements; the new atmospheric gases, helium, neon, argon, krypton and xenon; lithium, rubidium and calsium; beryllium; gallium, indium, thallium; germanium and titanium.—*Electrochem. Ind.*, January.

Units, Measurements and Instruments.

Flicker Photometer.—Simmance and Abady.—A (British) Phys. Soc'y paper in which the authors describe a flicker photometer, which is capable of balancing and comparing the most violently contrasted tints and which is based on the following principles: The light effects must be in juxtaposition without any apparent division line, and must move, oscillate or rotate so that the point of juncture of the rays of the two lights passes and returns entirely across the vision field. Any hiatus or longer exhibition of one light than the other biases the result. The observation surface or surfaces upon which the light rays fall must be at exactly the same distance from the eye, at exactly the same angle in relation to the line of sight, and must be of pure white, such as is afforded, for example, by clean chalk, plaster of paris, magnesium carbonate or barium sulphate, since any tint affects the accuracy of the results. The photometer itself consists of a wheel of a white material with a specially shaped periphery, which is caused to revolve before an eye-piece by means of a suitable motor. At right angles to the line of sight and parallel with the axis of the revolving wheel, are the two lights undergoing examination, the rays of which fall upon the shaped periphery of the wheel, enabling the effect of such light to be seen in turn through the eye-piece. The discussion which followed the reading of the paper turned mainly on two points: first, whether the instrument measures candle-power, and second, whether it is independent of the Purkinje effect. In his reply, Abady said that if a Bunsen disc is taken and used to compare the candle-powers of two lights of the same color, the grease spot vanishes at a certain point. If a flicker photometer is substituted for the Bunsen disc the flicker disappears at the same point. In both cases candle-power has been measured. Results obtained from the photometer by different observers agree among themselves and also with results obtained from the Bunsen disc photometer. He does not think the Purkinje effect affects the readings of a flicker photometer, because the same values for the ratio between the intensities of two different colored lights are obtained by varying the distances of the light from the instrument within wide limits.—Lond. *Elec.*, December 25.

REFERENCES.

Direct-Reading Scales for Slide-Wire Bridge.—Buckingham.—A brief article. When a large number of rough measurements are to be made on the slide-wire Wheatstone bridge, it is very convenient to have the scale so divided as to read directly the ratio of the two segments of the wire, thus obviating the necessity of calculating it or looking it up in Obach's table. While such scales are in common use, the author describes a simple geometrical construction for making them.—*Phys. Rev.*, November.

Comparing Low Resistances.—Wenner.—A brief description of a convenient method of comparing low resistances by means of the Wheatstone bridge.—*Phys. Rev.*, November.

Differential Duplex Telegraph System.—An illustrated description of a method devised 20 years ago by McGaurin and recently revived and improved by Janvey of the Australian telegraphic administration. Batteries are used at one end only. The method of producing the changes of line resistance which actuates the relays at the receiving end is described and illustrated in a diagram. It is thought that for short, well-insulated lines or for underground conductors this system may be perfectly reliable. The system was tried with success on a loop of 175 miles in length commencing and terminating in Melbourne.—Lond. *Elec.*, January 1.

Miscellaneous.

Metal and Mineral Productions.—The annual statistical number, giving statistical data on metal and mineral production in 1903, reviews of the markets, etc. The production of aluminum in the United States in 1903 was 7,500,000 pounds, valued at $2,325,000, as compared with 7,300,000 pounds, valued at $2,284,590 in 1901. The production of copper was 670,880,000 pounds, valued at $88,334,770 (against 610,815,384 pounds and $71,072,586 in 1902). The production of gold in the United States in 1903 was 3,600,645 troy ounces, valued at $74,425,340; besides the output of gold from domestic ores, a large quantity of gold is recovered by the refineries each year from foreign ores and bullion, the output from these sources in 1902 being valued at $34,932,211. The total output of desilverized, soft and antimonial lead produced in the United States in 1903, was 289,030 short tons, valued at $24,492,402, and in addition a production of 84,771 tons of lead from foreign ores and bullion. The output of silver from domestic ores was 56,519,793 trop ounces, valued at $30,520,688. The production of zinc was 156,318 short tons, valued at $16,882,344. There was a large increase in the output of banxite, which amounted to 40,700 short tons ($179,080), against 27,322 tons ($121,465), in 1902. The output of carborundum was 4,724,000 pounds ($472,400), against 3,741,500 pounds ($374,150), in 1902.—*Eng. & Min. Jour.*, January 7.

REFERENCE.

American Trade.—Dredge.—The first part of a long statistical article on the development of American trade, with a great many diagrams. The article is more of a general character dealing with the export trade of the United States and referring to electrical engineering only incidentally. A diagram of the exports from the United States of electrical machinery shows a rapidly ascending and nearly straight line from 1898 to 1901 and a slight dropping off from 1901 to 1902. The article is to be concluded.—*Traction and Transmission*, January.

New Books.

Distribution de l'Energie par Courants Polyphases. Par J. Rodet. 2 ieme Edition. Paris: Gauthier-Villars. 562 pages, 213 illustrations. Price, 15 francs.

The volume is one of the best text-books on alternating-current power transmission systems, printed in the French language. It is essentially intended for the use of electrical engineers and electrical enginering students.

The work is divided into nine chapters. The first chapter is preliminary. The second concerns polyphase generators, both synchronous and asynchronous. The third deals with polyphase conductors and conducting systems. The fourth chapter is devoted to the design, construction and principles of operation of transformers and frequency changers. The fifth chapter considers converters. The sixth deals with polyphase motors. The seventh with meters and measuring instruments. The eighth relates to the applications of polyphase currents to electric traction. The ninth and last chapter describes a number of typical polyphase plants and transmission systems in various parts of the world.

The treatment is clear and logical, employing algebra and engineering mathematics. The author has taken pains to deal with the subject broadly, and does not confine himself to French alternating-current practice. In fact, an American student can learn more about American transmission systems in their salient engineering features than he can find in a number of American books on the same subject.

The book would be improved by a subject-index and an author-index at the end. There is only a chapter-index. The work can be strongly recommended to students of electric power transmission.

Electric Heating Equipment of a Modern Hat Factory.

BY MAX LOEWENTHAL, E.E.

REGARDLESS of many adverse conditions, the electric heating industry has been making history during the last decade at a pace which is a surprise even to those who have witnessed the remarkable rise of other branches of electrical engineering. Largely responsible for this encouraging situation to-day are, first, a better understanding on the part of the manufacturers as to the needs of the consumer and the limitations of his products; secondly, the tendency of central station managers to make rate concessions to consumers using current for domestic or industrial heating, and finally the public's gradual but inevitable recognition of the advantages of electric heating for specific purposes. To the engineer, the application of electric heat to industrial operations is of particular interest, and a number of instances might be cited in support of the statement that cerain industries have been almost revolutionized and their products cheapened and improved after the introduction of electric heat.

Perhaps the most striking example of this is the use of electric heat in modern hat manufacture, where electric irons and other electrically-heated machines are not only rapidly replacing gas-heated devices, but have become almost indispensable factors, and where price competition must be met while the high standard of quality of product must be maintained. One of the first hat concerns in this country to recognize the advantages of electric heat, and back up their faith by a complete installation was the well-known firm of F. Berg & Co., of Orange Valley, N. J., manufacturers of soft felt hats. This firm, established in 1864, equipped their entire plant with electrically-heated apparatus as far back as September 1, 1898, and when their old plant burned down in 1902, they started at once to rebuild the works, rearing on the site of the old buildings the most up-to-date hat factory in this country, while manufacturing was temporarily carried on in the company's Newark establishment.

FIG. 1.—CORNER OF TRIMMING ROOM, SHOWING ELECTRIC CURLING MACHINES.

The new buildings, completed in the past summer, occupy a plot comprising several acres and represent an outlay of more than a quarter of a million dollars. It is claimed to be the only hat factory built according to a definitely conceived plan, housing within three splendid buildings the necessary machinery and men for an output of about 300 dozen hats per day. The two factory buildings are known in the trade as the "back shop," the smaller of the two, where the initial work is done and the "front shop," where the hats are finished. Although we are particularly interested in the "front shop," which contains the electric heating appliances, it might be well, in order to more fully comprehend the exact mission of the devices, to briefly describe the processes gone through in the manufacture of soft felt hats.

The first building to enter, then, is the "back shop," which runs parallel to the "front shop" or main building. It is built of brick, is two stories in height, 150 ft. long, 100 ft. wide and of the mill type of construction. On the first floor is the stock room for the raw fur as it is received from the fur cutters. This fur is first taken to the blowing room on the same floor, where the hair is separated from the fur by means of four blowers. The fur is then taken into the mixing room, where the various grades are mixed by an automatic machine. In the forming department, a definite quantity of this mixture is then placed around a perforated copper cone, which is dipped into hot water and taken to the sizing department on the second floor. Here the hats are "felted" by being soaked in boiling water and kneaded by hand and machines until the embryo hat has shrunk to its normal size. It is then dried and put through a stiffening machine, clear shellac being introduced into the brim of the hat. Thence the hat is sent into the dyeing department on the same floor, where it receives its proper shade, which varies largely with

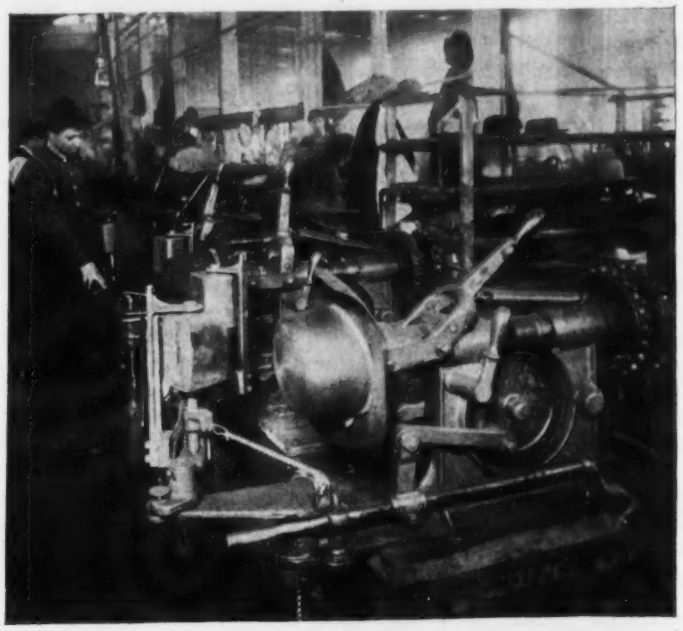


FIG. 2.—PORTION OF MAIN FINISHING ROOM, SHOWING ELECTRIC MACHINE HAT IRONS.

the demand of the market. The shape and size are next given to the hat in the blocking and stretching departments, after which it is thoroughly dried by steam driers and passed down to the pouncing department on the first floor, where it is machine sand papered internally and externally. The hat is then sent to the stock room, from where it is delivered in due time to the finishing department on the top floor of the "front shop." This building, constructed of brick, is three stories in height and has a basement, each floor being 14 ft. high. Its dimensions are 175 x 50 ft. Its roof is a series of skylights, giving the best possible light to the finishing departments on the third floor. The main room on this floor is 100 ft. long by 45 ft. wide, and at the other end of the building is another finishing room measuring 65 x 45 feet. In these two rooms 200 men are employed "finishing," or as it might be more commonly called, "ironing" the hats.

This is done with electrically-heated hand shells, each weighing about 15 pounds and consuming between 400 and 450 watts. The shells are of a uniform shape, which has resulted from many years' use by journeyman hatters. The shells, 200 in number, are equipped with Prometheus electric heating units. The conducting layer of these units consists of a thin metallic film on mica, another piece of mica being used as a cover plate. The two pieces of mica are enclosed in a sheet metal casing and suitable terminals are brought out. A unit of this description is slipped into the hollow shell and pressed against the bottom surface by means of a heavy iron pressure plate, which is forced against the unit by a bolt operating two sliding wedge blocks. A smaller unit is fastened to a projection on the pressure plate and serves to heat the one side of the shell, used for "veluring." For this purpose the shell is inclined on projections on the iron stand and the operator heats a cloth pad held in his hand on this side of the shell. These heating units not alone insure uniformity of temperature, but may be replaced in case of necessity by the workman himself. An idea of the flexibility of this system may be gained from the fact that all the old shells which had gone through the fire were in a very short space of time equipped with the heating units.

Fig. 3 shows one of the hand shell operators at work and, as

will be seen, each shell is connected to a separate small knife switch on the wall. The operator's work consists in stretching the hat over a wooden block of the right shape and size, first making it pliable over steam and removing superfluous hair by holding the hat in a singeing stove, and then finishing or ironing the same and trimming the brim to the proper width by means of a gauged knife.

At the further end of this floor twenty-eight ironing machines are located, divided into four gangs of seven each, belted to a countershaft driven by a motor. A gang of these machines, shown in Fig. 2, is looked after by a boy and all his work consists of is to "feed" the blocks with hats and start and stop the shell which travels around the hat, regardless of the shape, the tension being maintained by means of its suspended weight. These machine shells differ from the hand shells in that their faces are slightly curved, while the hand shell faces are perfectly flat, and instead of a handle they are supplied with a shaft at one end, which fits into and revolves in a bearing fastened to an arm, which carries the shell around the surface of the hat. The working face of these shells only is heated and a Prometheus heating unit is held against the easily-removable bottom by means of a heavy pressure plate fastened down by screws. A flexible connecting cord leads from two terminals at the lower end of the shell to a cut-out block at the side of each machine. The watt consumption of these shelves is the same as that of the hand shells.

The many advantages of electrically-heated shells over gas-heated shells, namely safety, cleanliness, better sanitary conditions, reduced operating expenses and lower insurance rates are supplemented in the case of machine shells by the fact that no matter how much the electrically-heated shell may be jarred, the heat supplied is constant and steady, which greatly enhances the efficiency of the operator tending a group of these machines.

From the finishing departments the hats are sent to the floor below where they are passed upon by an inspector and then to the curling machines shown in Fig. 1. In these an electrically-heated revolving disc curls the edge of the brim, the heaters almost entirely surrounding the disc. It needs no argument to show the decided advantage

FIG. 3.—CORNER IN MAIN FINISHING ROOM, SHOWING MANNER OF USING ELECTRIC HAND IRON.

of this method of heating the disc over the old method of projecting against it, and almost into the face of the operator, a jet of gas.

In a large room at the other end of this floor 200 girl operatives sew the various trimmings on the hats, all the sewing machines being electrically driven. In the flanging room on the first floor twenty flanging bags are used for giving the brim its final shape. These bags, which are filled with sand, are at present heated externally on steam tables, but they will probably be heated internally by means of electric heaters in the near future. Fifteen additional electric hand irons are used by the flanging bag operators, shown at work in Fig. 4.

The power house, a pretentious brick structure, occupying a plot 50 ft. by 95 ft., on the company's spacious site, is divided by a heavy fire wall in two sections. In the one are located four Coatesville horizontal tubular boilers, 200 hp each, equipped with the Parsons patent forced draught system, in which superheated steam mixes with the air in the ash pit. Natural draft is obtained from a steel stack 100 ft. high and 6 ft. in diameter. Green economizers and Berryman heaters are used for the heating of the boiler feed water. Three Worthington pumps furnish the water for the boiler and house supply. In the spacious engine room two Fitchburg horizontal, tandem compound, 300-hp engines are direct-connected to two Stanley 200-kw inductor type 60-cycle, 7,200 alternations, two-phase generators, delivering current at 220 volts, and being supplied with automatic phase regulator windings.

One 12-kw and one 24-kw Northern exciter are belted, respectively, to the two generators. The switchboard, consisting of five blue Vermont marble panels, is 17 ft. long and 9 ft. high and is so located that it may be easily seen from any part of the engine room. One of the end panels is used as the exciter panel and is equipped with two ammeters and one voltmeter, of the Stanley type and exciter switches. Adjoining this panel are two generator panels with the usual equipment, the next is the light and heat panel and finally the power panel. In a separate building adjoining the power plant a 100,000-gallon pump is housed which furnishes the water supply for the extensive

FIG. 4.—FLANGING ROOM, SHOWING FLANGING BAGS AND ELECTRIC HAND IRONS.

sprinkler system installed throughout the buildings, there being a total of 1,200 sprinkler heads. The average load on the system is 900 amp. at 220 volts, which is the pressure employed for the operation of the motors, of which there are 30, ranging in capacity from 3 to 30 hp; 800 lights are scattered throughout the buildings and they, as well as the heating appliances, are operated on 110-volt circuits. That these devices are important factors in the operation of a modern hat factory may be gathered from the fact that one-half of the entire average output of the plant described above is consumed by electrically-heated devices, approximating 100 kw.

The designers and owners of this establishment, where steam and gas have been so largely supplanted by electricity, must certainly have been convinced of the truth of the statement, made recently by a well-known engineer, that "An electrically-driven, electrically-heated and electrically-lighted tool is as perfect a combination for good work as it is possible to make." The entire plant was designed and erected under the personal supervision of Mr. Luther D. Martin, of the Taylor-Martin Engineering Co., Newark, N. J., who was retained as consulting engineer by F. Berg & Co., in view of his experience in the design of hat factories. The electric heating equipment was supplied by the Prometheus Electric Company, of New York.

Heavy Traction in England.

A contract for the equipment of a large three-phase electrical generating station to be erected by the Great Western Railway Company at Park Royal, near London, has been secured by the Electric Construction Co., of London and Wolverhampton. The station will require about 10,000 hp of plant, available for either lighting or traction. The North Eastern Railway Company has recently carried out extended and satisfactory trials of the newly electrified branch of their line between Newcastle and Monk Seaton Station, on the other side of Tynemouth. The distance is about 10 miles, with a double track, making the length of rails traversed rather over 20 miles. Mr. Philip Dawson is understood to have been at work for some time on electric traction projects for the London, Brighton & South Coast system.

Central Station Feeder Regulators.

The accompanying illustrations show a type of central station feeder regulator made by the General Electric Company for alternating-current circuits, which is free from the objection of introducing lagging currents. The regulator is of the transformer type, having its primary connected across the bus-bar and its secondary wound in several sections controlled by a dial switch. The amount by which

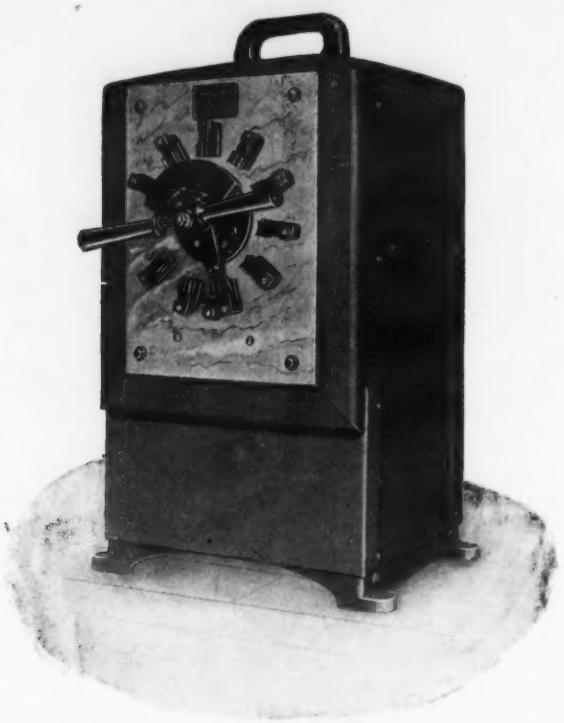


FIG. 1.—REGULATOR.

the generator voltage is raised or depressed on the feeder is determined by the amount of secondary winding included in the feeder circuit. The windings of the regulator, being arranged similarly to those of the usual transformer, are free from all appreciable reactance, and the regulator does not, therefore, introduce a lagging current into the system, as is the case with apparatus which contain a large amount of reactance, the presence of which is a necessary consequence of the principle of regulation.

The control of the feeder by means of this regulator is of the simplest nature. Starting with the regulator in position of maximum boost, that is, with the dial switch turned to the extreme left as far as it will go, a continuous right-handed movement of the dial switch

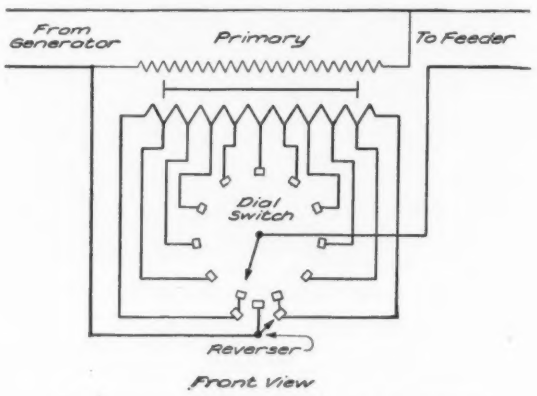


FIG. 2.—DIAGRAM OF SWITCH CONNECTIONS.

for two complete revolutions is obtained. During the first revolution the switch cuts out, step by step, the ten sections of secondary winding. When the first revolution has been completed, the voltage on the feeder is the same as that of the generator, no secondary winding being included. A further movement of the switch in the same direction automatically throws a reversing switch on the back of the panel, and continuing the movement of the dial switch, still in the same direction, the secondary windings are again switched in, step by step, this time with reversed polarity; so that when the second revolution is complete the whole secondary winding is again included in the feeder, but now opposing the voltage of the generator.

Thus by one continuous movement of the switch, covering two revolutions in one direction, the complete range between maximum boost and maximum depression of the feeder voltage is covered. At either end of this range the switch is automatically arrested, so that it is impossible to turn it too far.

The dial switch embodies a number of improvements, designed to overcome objections in other forms of apparatus intended for a similar purpose. In the dial switch, the awkward combination of split contact fingers and reactive shunt is avoided and the switch operates with a positive "snap" movement from step to step, regardless of the manner in which the operating handle is manipulated. This is accomplished by means of compression springs interposed between operating handle and the traveling blade.

An automatic bolt holds the switch on its contact point until the bolt is withdrawn by a self-acting cam, when the spring has received

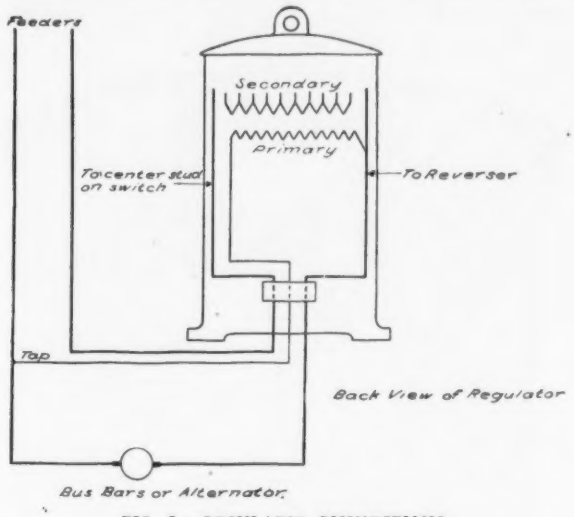


FIG. 3.—REGULATOR CONNECTIONS.

sufficient compression to carry the blade with a quick movement onto the next contact, on which it is instantly locked again by the bolt. Owing to the quickness of movement obtained, together with the special shaping of the contact blades, no flicker on the lamps is observed when the switch is moved from step to step.

The contact blades are of heavy copper with turned edges arranged to chill, by their mass, the momentary arc which occurs when passing from point to point; thus avoiding damage from arcing. If after prolonged service it should become desirable to renew these contact blades, they can be readily removed and replaced.

Fig. 1 shows the appearance of the standard regulator as usually installed at the station and in some special cases at the center of distribution. The core is of the cylindrical type and with its winding stands vertically within a well ventilated frame with sheet iron panels.

Fig. 2 shows the general arrangement for connecting the various sections of the secondary winding to the dial switch; also the electrical connection of the reversing switch. This latter is operated by an arm attached to the main shaft.

Fig. 3 shows the connection of the regulator to the generator and feeders. It will be seen that three leads only have to be connected in order to place the regulator in service.

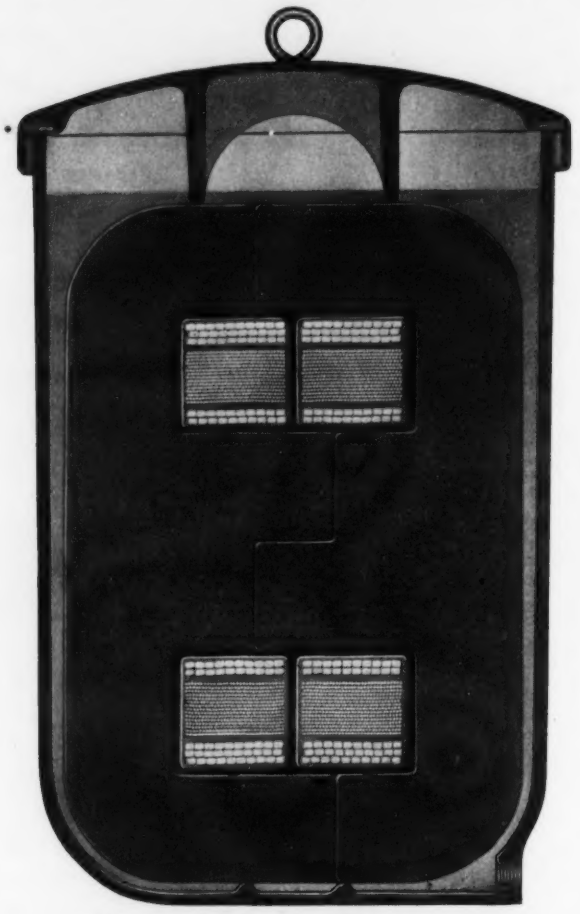
Fire Losses.

It is of much interest to electrical people to note that the property losses in the United States and Canada through fires the past year are estimated to have reached an aggregate of about $152,000,000, allowing for a probable loss of $13,000,000 in the month of December, whose figures are yet to be tabulated. On this showing there was a decline of fully $9,000,000 in the total fire waste as compared with 1902, which showed losses of $161,000,000. The real extent of the gain to underwriters becomes more evident when 1901, with its aggregate of $169,500,000 in losses, and 1900, with its loss record of about $178,000,000, are recalled. Thus 1903 has yielded a fire waste of about $26,000,000 less than that of 1900. There does not appear, however, to be any abatement in the demands of Fire Underwriters for increased precaution at the expense of the insured, nor any sign of reduction of rates.

Practical Study of Transformer Design.

The fact that technical literature used in our colleges can be effectively supplemented by the assistance of manufacturing concerns was strikingly illustrated recently in a transaction between the University of Iowa and the Fort Wayne Electric Works, Fort Wayne, Ind. In class room work an instructor is often handicapped in lecturing on electrical design by lack of suitable illustrating matter on the subject under discussion. This applies particularly to modern standard practice, which is often lacking in up-to-date technical text-books. To supply this omission at the University of Iowa, correspondence was opened by Prof. Spinney with the Fort Wayne Electric Works, regarding the possibility of effectively illustrating transformer construction. The type A oil-insulated Wood transformer was selected as a suitable preferred design for illustrating shell type construction as applied to lighting transformers.

In order to obtain the most satisfactory results in class room work,



CROSS-SECTION OF MODEL TRANSFORMER.

a full-sized model of the cross-section of the transformer was constructed and mounted in a suitable glass-covered case for suspending on the class room walls. An illustration of this cross-section model is shown herewith. It will be noticed that nearly all of the points of construction which would be considered in economical commercial design are effectively shown in this illustration.

The cross-section was taken across the coils through the center of the core. In constructing this model a thin section of coils and core was mounted on a board cut to conform with the outlines of such transformers. Around the edge of this board was built up a reproduction of the section of the transformer case the same thickness as the section of core and coils. Felt gaskets under the cover, oil within the case and other features hard to reproduce were represented by the proper color paint. The dimensions of all parts and proportion of different parts were made exactly the same as in a transformer of this size, to show the high insulation between primary and secondary coils and core. In this way also was shown the close proximity of the core to the case and the short conducting path through oil, which is interposed between the core and case on all sides.

Another feature shown is the method adopted in the design of the transformer to make it suitable for operation on three-wire circuits, by dividing the primary and secondary coils into several sections separated from each other by insulating materials and oil space and occupying different positions with respect to the magnetic circuit. The protection to the primary from both moisture and injury is also illustrated, the coarse wire of the secondary surrounding the fine primary conductors on the two sides most liable to injury. The core construction is also plainly seen to consist of a single punching, which is used in pairs to make a single complete lamination in the core.

The magnetic circuits are short and of low reluctance, because of the large area of contact between the two sides of the gaps in the magnetic path. The transformer requires a minimum amount of oil for insulation and conduction, because of the close conformity of the shape of the case to that of the assembled core and coils and the most efficient use made of the relatively small amount. Mechanical construction of the case furnishes means for holding the core rigidly in the proper position in the case without the use of angle irons or bracket construction of frame.

The use of the vacuum drying and substitution process employed in the construction of the coils is shown by the uniform spacing and straight regular arrangement of the conductors in different layers of the primary and secondary.

Telephone Card Index Bracket.

Mr. M. Holtz, the secretary of the *Dry Goods Economist*, a well-known trade paper, has recently, by reason of the constant annoyance and delay incurred in looking up names and numbers in the New York telephone directory, invented a very practical attachment for the purpose of giving the subscriber means of instant reference to a name and number. It consists of a nickel bracket attached to the post of the portable telephone above the receiver hook with a

TELEPHONE CARD INDEX BRACKET.

slotted bracket containing cards arranged as in a card index permitting any classification by business, alphabetically or any other way that suits the convenience of the user. A card may be withdrawn and any number of names of the same general classification up to the capacity of the card may be seen at a glance and the card will drop back in its place by its own weight. The projecting tabs on the top of the cards give an instant guide to the contents and permit of ready withdrawal of any card or cards.

One great advantage of this attachment is in its permanent attachment to a portable desk telephone which is being constantly shifted around from one place to another, where wall card index books or other separate devices lose their value by reason of not being handy when wanted. This is entirely obviated in the case of this attachment. This invention should also make possible a great saving on the part of telephone companies. The cost of revising and publishing directories is a very large item. With the general use of this attachment by a local company the average subscriber would have little occasion to look in the telephone book.

It will be readily seen that the first card is instantly visible to the user of the telephone—this card being reserved for most frequent calls. Furthermore, its use will permit an exchange operator to repeat back a wrong or changed number call and requesting it be changed on the card, avoiding a recurrence of the same error.

Electricity in Typesetting and Printing.

A considerable amount of space has been given lately to illustrating and describing in the pages of ELECTRICAL WORLD AND ENGINEER the various processes dependent upon electricity in some form and employed in the Government Printing Office at Washington. The multiplicity of such processes was bewildering and many readers in commenting upon them have expressed the belief that the list was exhausted. This, however, is not likely to be the

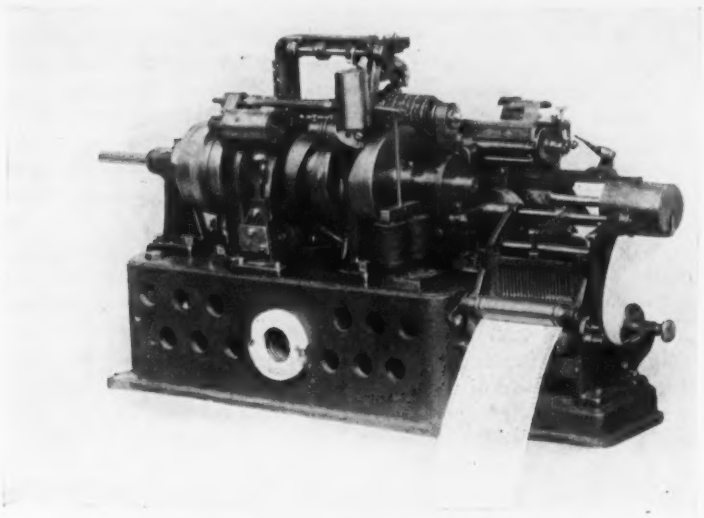


FIG. I.—PART OF TRANSFER PRINTING MECHANISM.

case for a long time to come; and we are now able to signalize a further departure, to which we have in fact already directed attention. The device is known as the "lithotype" and provides not only for typesetting electrically, but for printing with smooth aluminum plates on rotary presses; so that, in a broad sense the principles of lithography may be said to be applied. The invention is striking also for what it eliminates from the ordinary printing office mechanism and equipment, since it proposes not only to do away with the setting and distribution of type, whether by hand or machine, but does away also at one sweep with matrix making, stereotyping or electrotyping. The inventor is Mr. Walter S. Timmis, consulting engineer of the Sackett & Wilhelms Company, to whom several patents are issuing; while the introduction of the aluminum plate is to the credit of Mr. John Mullaly, president of the United States Aluminum Printing Plate Company.

The apparatus was seen in full operation in New York last week by a member of the staff of this journal. As then studied, the lithotype consists of two parts or devices operating separately. Arrangements, however, have been made to co-ordinate these parts. The first, shown in Fig. 2, and seen operated by a young woman, consists of a small machine comprising an electrical keyboard similar to that of the ordinary typewriter, a perforating device to perforate a stout manila paper ribbon or strip of any required length, and a counting device. The perforating device is operated electrically by electromagnets grouped back and under the mechanism so as to give control by armature pull of the punches making the perforations, and controlled by the depression of the keys through the circuit-closing devices associated therewith. The machine automatically takes care of the spaces between the words. The holes in the strip when it is put on the next machine in the process are translated duly into the letters actuated originally on the typewriter keyboard. The magnets can be run on an ordinary light or power circuit, preferably with a condenser in circuit to avoid "arcing."

The perforated strip goes directly into the second part of the combination, shown in Fig. 1, which operates to bring the printing member into position, so that the selected character is directly opposite the printing point. The character is then inked, the paper is moved up to the character and the impression is taken therefrom. This action is repeated for each character until the line is completed, when the paper-carrying device returns and moves for the new line. Power is furnished conveniently to keep the machine running by a small electric motor. The transfer thus obtained is now ready to be impressed on the surface of the prepared aluminum plate.

The plate, with the imposed transfer, is put under pressure, the paper is washed off, the impression thus made is "rolled up," and then, with a few finishing touches, is ready for the press.

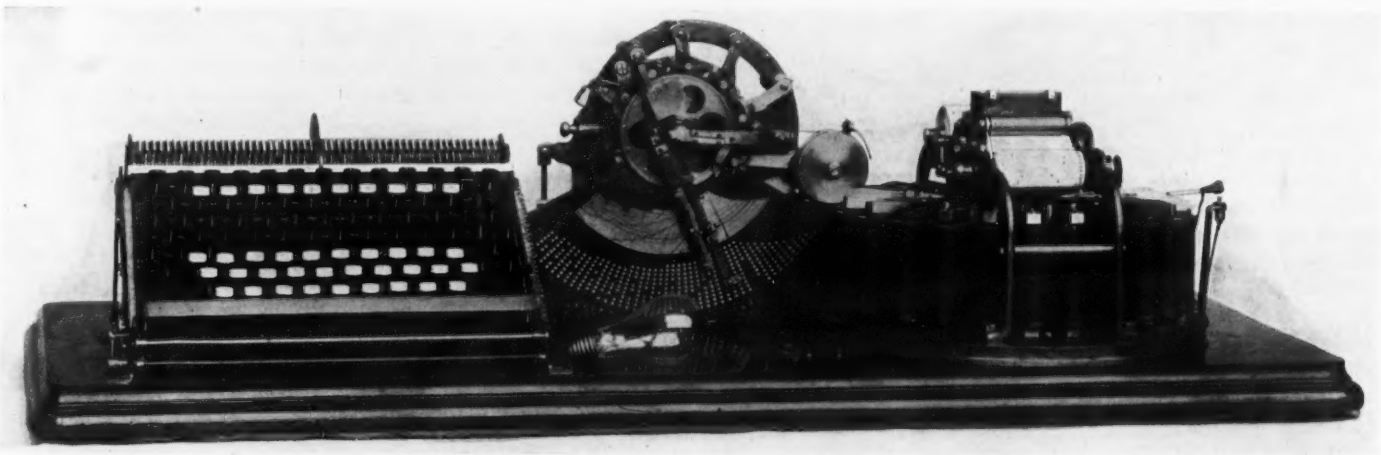


FIG. 2.—GENERAL VIEW OF THE "LITHOTYPE" PUNCHING MECHANISM.

High Pressure Gas Distribution by Gas Power.

A gas-power installation of exceptional interest is now under construction by the Laclede Gas Light Company, of St. Louis, Mo. The system has for its object more efficient distribution of gas over larger areas than may be economically covered by the simple method of running large low-pressure mains from a centrally-located gas-generating plant to supply all parts of the city. The system under construction is intended to supply the entire city of St. Louis, embracing an area of approximately 65 square miles. In order to serve the outlying districts of such an area, one of three methods must be employed: First, large low-pressure feeder from central holder to center of district to be covered; second, medium-sized feeders from main holder to auxiliary holder in center of district, and third, high-pressure feeder to distributing center, using pressure-reducing valves at this point for obtaining proper pressure upon the service lines. The enormous expense for construction entailed by the first two methods has practically prohibited their use in St. Louis, and the high-pressure system is being installed. With this system, the size of feeder pipes is greatly reduced, and the necessity of auxiliary district holders is entirely done away with.

For serving suburban communities, lying far beyond the city limits, this method may be extended and the pressure of the gas raised to any desirable extent for transmission through small pipes, this pressure being reduced at the suburban distributing center by pressure regulators, as in the medium-pressure system above mentioned. This gas-distribution system as a whole presents a striking similarity to the ordinary alternating-current distribution system with primary high-pressure feeders, reducing transformers and secondary low-pressure distributing lines, the theory of high-pressure transmission being in both cases identical.

The pressures to be employed in the system under construction

at St. Louis are approximately 5 lbs. per square inch for the medium-pressure feeders and from 20 to 80 lbs. per square inch for the high-pressure suburban feeders. On account of the use of cast-iron mains, the 5-lb. limit was chosen for the medium-pressure system, but for the high-pressure system iron pipe with screwed fittings will be used. With this construction any desirable pressure may be carried with entire safety, and the radius of distribution extended to 100 miles, if necessary.

The gas pressure will be supplied by a blowing unit, consisting of a standard Connersville blower direct-driven by a 300-hp Westinghouse horizontal gas engine of the type recently brought out for high-power work. The engine has two double-acting cylinders, 16½ in. in diameter and 24 in. stroke, arranged in tandem with a single crank, and uses for fuel the ordinary illuminating gas drawn directly from the gas mains. The engine operates upon the four-stroke cycle, and the method of governing secures a constant quality of explosive mixture at all loads, the quantity of the mixture being proportioned by the governor to the load of the engine. Electric ignition is employed. In this particular installation the engine is controlled by an automatic pressure-governor which adjusts the speed of the unit in direct proportion to the demand for gas, the speed thus being in inverse proportion to the pressure in the distribution main. So sensitive is this control that the variation in pressure will not exceed 8 oz. for a 50 per cent. range in gas output. The regular centrifugal speed-governor is, however, also used in order to prevent, under any conditions, the engine running at excessive speed.

The St. Louis installation is one of the first of its kind in the illuminating-gas field and presents many interesting features which will be subsequently brought out in special articles at the completion of the work. The system has, however, long been in successful use in the distribution of natural gas over large districts adjacent to natural gas fields. The St. Louis system is in charge of Mr. W. A. Baehr, engineer of the Laclede Gas Light Company.

Northwestern Electrical Convention Notes.

The exhibits at the Northwestern Electrical Association's winter convention at Milwaukee this year, although not extensive, included some apparatus of much interest to central station men. Nearly all the parlors on the second floor of Hotel Pfister were occupied by the supply men as exhibition and reception rooms.

THE GENERAL ELECTRIC COMPANY made no attempt at a display, but had headquarters in one of the parlors. Its interests were well looked after by Mr. F. N. Boyer, manager of the supply department; Mr. J. Scribner, manager of the lighting department; Thomas Ferris, Wisconsin representative; S. F. Dibble, manager small motor department; W. J. Ferris, of the Chicago office, and James Lyman, engineer Chicago office, who read a most interesting paper on steam turbines before the convention.

THE HOLOPHANE GLASS COMPANY was well represented by its Western distributors, the V. R. Lansingh Co., of Chicago. With its well-known generosity the company presented to its visitors two samples of its Holophane globes and Pagoda reflectors, which retail for $1.15. The news of this, the most expensive souvenirs presented at the convention, soon spread and the already crowded rooms of the company were soon filled to overflowing. The crowd, however, was well handled by V. R. Lansingh and H. M. Lauritzen and each man, after seeing the dark room tests, was presented with the globes. One of the most interesting of the tests in the dark room was that of a 50-cp power lamp on one side and a 6-cp lamp covered with a reflector on the other, the latter showing at least double downward illumination. Another of this company's exhibits was a large board over the doorway fitted with colored lamps with Holophanes and Pagodas, which was connected with a Reynolds flasher. This gave beautiful and startling effects, as the colors were rapidly shifted. The room was beautifully lighted by a new six-light cluster, using a special Benjamin body and six pagodas. Every corner of the room was so evenly lighted that the management of the hotel at once placed an order for 60 of the clusters to light its sample rooms. The best display of this company, however, was the Pfister Hotel itself. The entire lobby, first floor and banquet hall, were equipped with Holophanes over a year ago, every 16-cp lamp being replaced by 10-cp lamps, giving at the same time a marked increase in illumination with the well-known softening and diffusing effect of the Holophane system. So satisfactory has this proved that the management placed their order during the convention for equipping the dining-rooms, corridors, etc.

JULIUS ANDRAE & SONS CO., of Milwaukee, had an extensive display of the various electrical supplies for which it is agent, looked after by J. C. Schmidtbauer, sales manager; F. T. Andrae, vice-president and A. E. Stadlbauer, salesman.

THE CROUSE-HINDS ELECTRIC COMPANY, represented by F. F. Skeel, Western sales manager, of Chicago, exhibited a line of its switches, tablet boards and Norbitt specialties. Their new Imperial car headlight attracted especial attention.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, of Lafayette, Ind., exhibited a number of its latest type of direct-current meters. Particular attention was drawn to the new method of compensating for friction which consists of a very neat and small multipoint switch placed within the meter and having its contacts connected with various turns of the compensating coil. By the mere movement of the switch lever any desired compensation for friction or vibration can be obtained in an instant. This new feature eliminates entirely the old and clumsy method of moving the compensating coil bodily to effect the compensation. It is also free from the objection of having the compensating coil disturbed or changed by the action of the series coils on short circuit. Another commendable feature is the new visual bearing, which permits of an inspection of the bearings while the meter is in operation, besides allowing the spindle point to be removed for renewals or examination with a special tool. A marked improvement is noticeable in the threadless jewel post by virtue of its simplicity and the quickness with which it can be taken out and replaced again. The binding posts are made both dust and fire-proof, and the spindle is constructed from nickel-steel tubing. The company was represented by Mr. Thomas Duncan and William Cothrell, of the engineering staff.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY received visitors and distributed bulletins in one of the parlors. A number of its well-known meters were arranged for the inspection of the members attending the convention. Messrs. A. L. Millard, W. E. McDonald and Norman Stewart were in attendance and extolled the virtues of the Westinghouse apparatus.

THE SAWYER-MAN ELECTRIC COMPANY did not make any exhibit, but was represented in the person of Mr. C. A. Ross, of its sales staff.

THE NATIONAL ELECTRIC COMPANY sent a cordial invitation to all the members of the Northwestern Electrical Association to visit its plant at Park Place and the river and inspect the manufacture of National Electric machinery and Christensen air brakes. A trip to the factory disclosed the various types of direct and alternating-current machines of the most modern type, in course of construction. A guide accompanied the visitors throughout the shops and explained the various processes of manufacture. The invitation also contained several car tickets of the Milwaukee Electric Railway & Light Company, and directions for readily reaching the plant. At the Pfister Hotel the company occupied a parlor in which several small motors, armatures, coils and apparatus were shown. Several large photographs served to show the larger apparatus which the company has turned out in the past. The interests of the company were taken care of by H. M. Klingenfeld, advertising agent; C. G. Burton, Chicago manager electrical sales; A. P. Peck, salesman; C. P. Tolman, A. E. Knight, engineers, and W. L. Waters, chief engineer, who read a paper before the convention on "Double-Current Generators."

THE BRYAN-MARSH COMPANY had George C. Keech, general manager of Chicago; L. P. Sawyer, manager the Minneapolis branch; J. L. Barnard, Wisconsin representative, and J. S. Corby, Illinois representative, receiving delegates at its headquarters.

THE PHELPS COMPANY had its interests in charge of W. E. Phelps, who exhibited a line of the Phelps specialties.

THE PARDRIDGE REFLECTOR was very much in evidence in the Convention Hall and in the corridors of the hotel. Cards about the hotels called attention to the fact that they increase the light 500 per cent. in a given direction and fit in places where others will not get. They need no shade holder and fit on any lamp from 2 to 50 cp in sizes. Mr. A. J. Pardridge did not fail to acquaint the various delegates with the merits of his invention.

THE WAGNER ELECTRIC MANUFACTURING COMPANY and the BULLOCK ELECTRIC MANUFACTURING COMPANY showed a line of their alternating and direct-current motors in one of the parlors. Mr. E. S. Bissell, assistant manager of sales at St. Louis, represented the

former, while L. G. Bassett and H. J. Meyer represented the latter.

THE STANDARD UNDERGROUND CABLE COMPANY, although not represented, as usual, by Mr. Wiley, nevertheless was well taken care of by Mr. E. J. Pietzcker.

THE KUHLMAN ELECTRIC COMPANY, of Elkhardt, Ind., although not making an exhibit, nevertheless was very much in evidence in the person of Mr. E. Kuhlman.

MR. F. L. MERRILL, of the Standard Railway Materials Company, of Chicago, renewed old acquaintances at the convention.

THE BROWNING COMPANY, of Milwaukee, made an exhibit of its new line of motors, which range in size from 3 to 30 hp. They were represented by Mr. William Stark Smith, sales manager; Franklin Sweet, mechanical engineer, and F. W. Ells, electrical engineer.

THE CENTRAL ELECTRIC COMPANY, of Chicago, although occupying one of the larger parlors, contented itself with renewing acquaintances and keeping in evidence in the persons of J. W. Mason, sales manager, and W. W. Geisse, their Wisconsin salesman.

MR. WILLIAM M. PORTER, as Western sales manager, represented the Alphaduct Manufacturing Company. Pipe souvenirs, made of alphaduct, were distributed to the visitors.

THE KESTER ELECTRIC MANUFACTURING COMPANY showed a line of their self-fluxing solder. Mr. F. G. Dickerson, secretary; A. J. Witherall, president, and J. E. Goodwin, salesman, extolled the merits of the company's products.

MR. W. H. SCHOTT, the well-known heating engineer of Chicago, received his many friends in one of the parlors.

THE FORT WAYNE ELECTRIC WORKS made an exhibit of its direct and alternating-current arc lamps and the type "K" meters. Their standard bulletins and literature were distributed among visitors at their parlors. The latter were received by W. S. Goll, the Chicago manager; C. E. Sedgwick and J. S. Raymond, of the Chicago office.

THE NERNST LAMP and its excellent qualities, although not requiring specially to be brought to the attention of the delegates, nevertheless were explained in an interesting manner by Mr. G. E. Bennett, the assistant manager of the Chicago office. A new throw-away holder, which is practically fool-proof, was brought to the attention of the visitors at the parlors. This overcomes any objections which may have been raised in the past against the former method of renewing both the glowers and heaters.

THE WALKER ELECTRIC COMPANY, of Philadelphia, showed a line of its well-known type of switches. The exhibit was in charge of Mr. J. R. Kimball.

THE MILWAUKEE ELECTRIC COMPANY had an exhibit of its well-known line of motors in one of the parlors. Mr. W. Cary, the vice-president of the company and manager of sales, was ably assisted by Mr. I. B. Cary, of the sales department, and T. G. Whaling, the secretary and assistant treasurer.

THE TRIUMPH ELECTRIC COMPANY was represented at the convention by Mr. Jacobs.

THE AMERICAN CIRCULAR LOOM COMPANY exhibited its well-known product and was represented by Mr. Thomas G. Grier, its Western manager.

THE THOMAS G. GRIER COMPANY, of Chicago, made an extensive display of the various specialties which it sells. These included the Kinsman reflectors, Wotton gongs, Hubbell specialties and Wirt rheostats and theatre dimmers. Mr. Thomas Grier, the president of the company, and George A. Gray, sales manager, were in charge of the company's interests.

THE HALLER MACHINE COMPANY, of Chicago, displayed a new line of metal electric signs and dimmers for flashing signs. Mr. William Goltz, the secretary and treasurer, and W. E. St. Clair, superintendent of shops, explained the good points of their apparatus.

THE ELECTRIC STORAGE BATTERY COMPANY was represented by Mr. G. H. Atkin, manager of the Chicago office, and J. M. S. Waring, engineer of the Chicago office, who read a paper on "The Storage Battery in Small Central Stations."

THE ELIOT ADDRESSING MACHINE COMPANY, of Boston, exhibited its machines for printing addresses on bills, papers, etc. The advantages of such a method and of the machines were presented to the delegates in an able manner by R. St. John and A. R. Baker.

Other companies represented at the convention, but not making exhibits were the George Cutter Company, George Cutter, president; the Simplex Electrical Company, W. F. Hruby; the Cutler-Hammer Company, H. H. Cutler, vice-president, and A. Beresford; General Incandescent Arc Light Company, Francis Raymond; American Electrical Works, F. E. Donohoe; Viscosity Oil Company, J. S. Blackford.

Stilwell-Bierce and Smith-Vaile Company's Affairs.

The bankruptcy proceedings instituted against the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, one of the largest builders of water turbines, pumps, etc., in this country, will not interfere with the operation of the plant, whose capacity is now taxed to the utmost. The petitioners are Frank J. McCormick, of the Dayton (Ohio) Supply Company, who has claims for $4,379.53, with interest; John W. Johnson, of Dayton, who files a bill of $1,963.82, with interest, and Alexander Gebhart & Co., also of Dayton, who put in an account for $10,994, with part interest. The petition has been lodged in the District Court of the United States, South Division of Ohio, West Division. Receivers have been appointed in the persons of H. E. Talbott, president of the Stilwell-Bierce & Smith-Vaile Company, and William B. Earnshaw, an attorney of Dayton. The company is incorporated under the laws of the State of New Jersey, with a capital of $1,100,000, practically all of which has been issued. The assets of the company are put at $2,000,000, while the liabilities foot up a total of $1,250,000. The contracts in hand are understood to represent at least $500,000. It is confidently expected that matters will be adjusted satisfactorily within the next month or so. The company is taking orders right along and is figuring on some substantial contracts, especially for export to South America and England, in which countries it has been doing quite an extensive business for some years past.

Distribution of Shawinigan Power.

The Shawinigan Water & Power Co., which recently closed a contract with the Sorel Electric Co. for the delivery of power at Sorel, Quebec, has completed the transmission line to deliver the current from Shawinigan Falls. To meet the requirements, a transformer station was built at Joliette, Que., where the 50,000-volt current from the main line is stepped down to a voltage of 12,500. A line was then built from Joliette to the banks of the St. Lawrence River near Lanorale, following the right of way of the Canadian Pacific Railway. Across the St. Lawrence the current is carried by a submarine copper cable, heavily insulated and armored with lead and steel wire. On the south side of the river the line follows the public road until it reaches Sorel. Necessary steps have been taken to obviate danger from the river current or pressure of ice in the spring. Aluminum cable has been used throughout, this cable being manufactured by the Northern Aluminum Company, at Shawinigan Falls, the whole line being of much lighter construction than that employed in the main transmission line. The construction work was carried out by Messrs. Johnson & Saunders, contractors, of Buffalo, N. Y., the submarine cable having been supplied by the American Steel & Wire Company, of Worcester, Mass. A second line to Montreal, with a capacity of 10,000 hp, will be built, and this Sorel line is only the beginning of a series of short lines which will tap the main lines and carry power to points between Shawinigan Falls and Montreal.

Automobile Manufacturers.

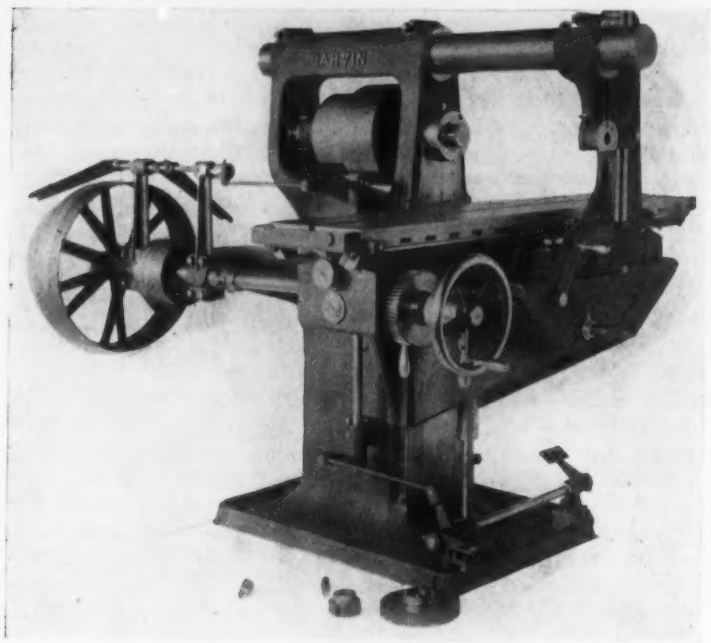
At a well-attended meeting of the executive Committee of the National Association of Automobile Manufacturers, which was held in New York last week, M. J. Budlong was re-elected president, while nearly all the other officers of the association were also retained. All the members of the executive committee were present except R. E. Olds. Windsor T. White was re-elected first vice-president; Charles Clifton, second vice-president, and R. E. Olds, third vice-president. W. R. Innis was elected treasurer in place of Percy Owen, who declined another term of office owing to increased business interests. The next meeting of the executive committee will be held on February 10, during the Chicago show. A special committee was empowered to enter into contracts for the automobile exhibits to be held at the St. Louis Exposition. It was reported that 40,150 square feet had been given to American manufacturers out of a total automobile space of 50,000 square feet. Mr. Budlong made an admirable report, with bright outlook, on the state of the industry.

Milling Machine for Brass Trolley Wire Hangers.

The accompanying illustration shows a milling machine made by the Garvin Machine Company for the rapid milling of brass trolley-wire hangers. It is fitted with power quick-return and automatic stop-motion. The machine is driven by a 5-in. belt, and the feed driven from the countershaft by a 24-in. pulley. The feed is direct through bevel and spur gears to a large steel screw or worm running in oil and meshing into a spiral rack or section of nut cut out of the solid on the under side of the table.

The hand-feed of the table is by hand wheel shown on front of saddle. This wheel is clutched so that it is not affected by the rapid rotation of the quick-return. Changes of feed are provided by change gears seen on front of saddle.

The feed stops at the end of the cut by automatic shifting of feed belt, and the work is taken out and quick-return thrown in by



MILLING MACHINE.

treadle action. The machine is controlled from either side. Special provision is made to check all over-run.

A long saddle is provided and supported by a very wide flat-top knee. The saddle is adjusted in and out by stop-nuts and bolted down on the knee by four bolts with swing handles, as shown. The vertical adjusting screw does not pass through the floor. The reverse is operated both by automatic trips and by hand or foot from either side of the machine. The cutter used is about 5 in. in diameter. In operation, the trolley hangers are held in a special fixture, and the chips flying up from the cutter are caught by an exhaust pipe and thrown into a barrel. Two flour barrels of chips per day gives a fair idea of the chip-removing capacity of the machine. A still further benefit of the exhaust, in addition to the removal of chips, is that it circulates air to the cutters and keeps them cool.

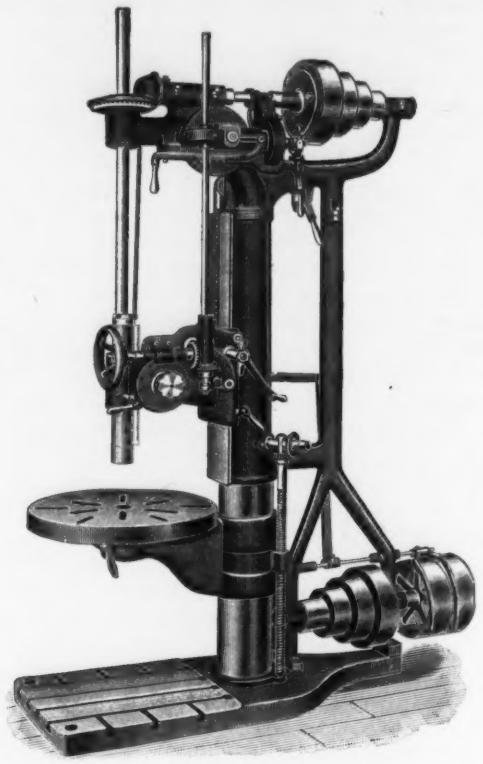
The length of the automatic feed is 50 in., and the in-and-out adjustment is 2 in. The feed is 48 in. per minute, the speed of the spindle being 550 r.p.m. The weight is 4,900 pounds and the floor space 5 ft. 6 in. x 9 ft. 6 in. The table is 62 x 13 in.

Positive Self-Feed Upright Drill.

A positive self-feed drill embodying many notable improvements, has been brought out by W. F. & John Barnes Co., Rockford, Ill. The illustration herewith shows plainly the construction. On the larger tools there are eight changes of feed, and on the smaller sizes four changes of feed. All these different feeds vary from one adapted for reamer work, or one for drilling in steel, to one of suitable coarseness for boring in cast iron.

A feed index plate is provided on each machine so that the operator may tell at a glance the feed being used. It is claimed that this positive feed will increase from 15 to 25 per cent. the output of a drill press; firstly, because the action is absolutely positive and does away with any slipping belts; secondly, the feed can be changed by a simple movement of the lever while the drill is running.

There is another point that the drill covers, in that it offers a variety of feeds adapted to the high-speed cutting steels that are

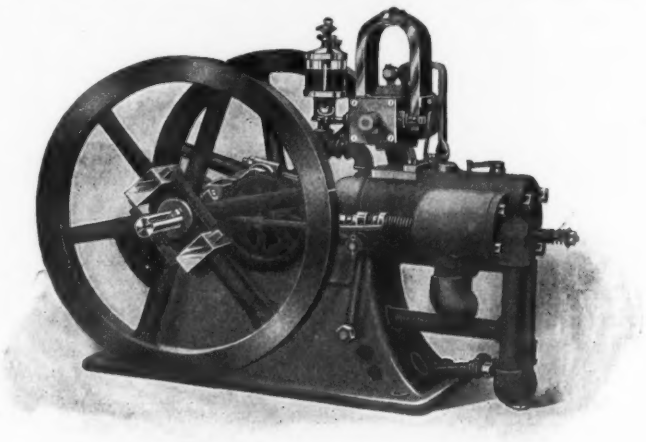


UPRIGHT LATHE.

on the market to-day. With the positive feed the operator is in position to use either slow-speed steel or high-speed steel. The question of high-speed steel is something to be considered, and machines must be adapted for their use.

Small Gas Engines.

The gas engine illustrated below is made up from castings furnished by the Carlisle & Finch Co., Cincinnati, Ohio. This engine will develop ½ hp at a speed of 375 r.p.m. The castings are furnished in the rough; the cylinder, however, is bored out and faced off, but no other work is done on any of the castings. A complete



SMALL GAS ENGINE.

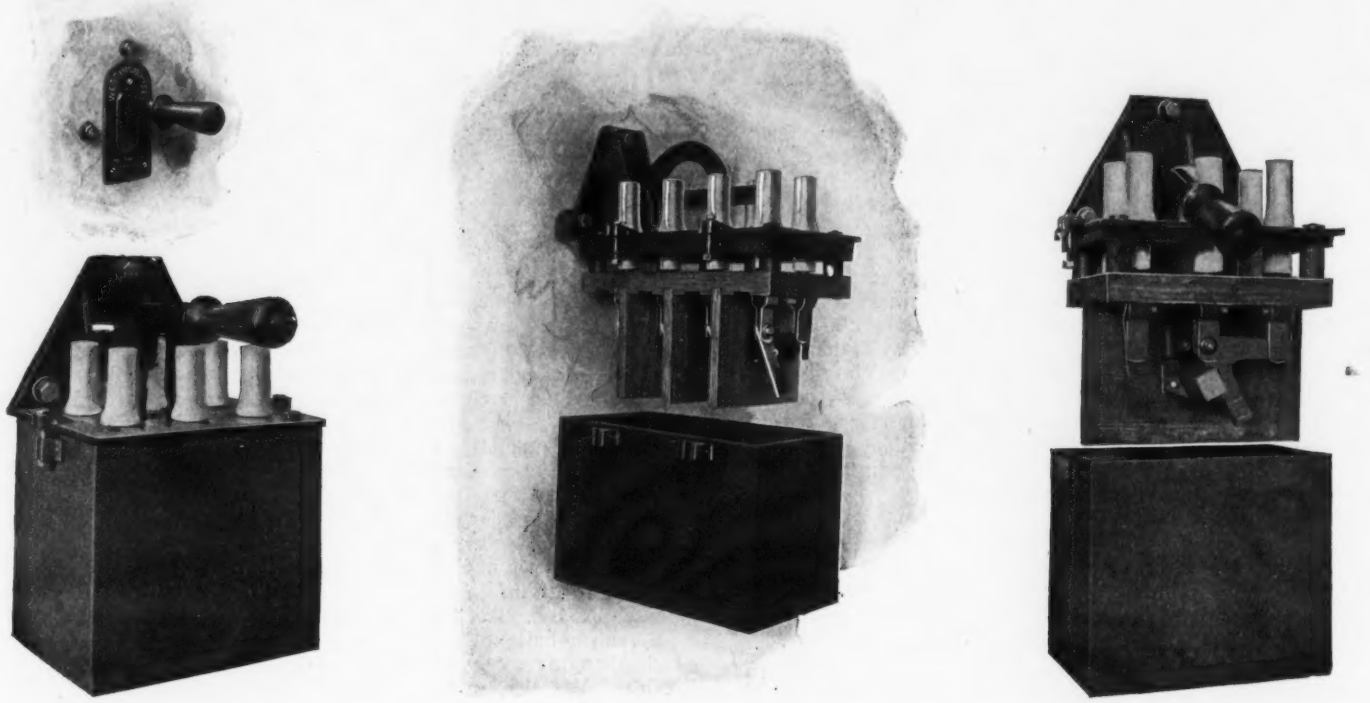
book of instructions telling how to perform every operation is furnished with the castings, and the manufacturer also furnishes all bolts, nuts, springs, screws, forgings, etc., so that nothing has to be purchased elsewhere in making up the finished engine.

The Carlisle & Finch Co. also makes a specialty of furnishing castings and dynamos, motors, electric miniature railways and a complete line of goods for amateur electricians.

New Westinghouse Oil Switch.

The value of oil as an insulating and arc suppressing medium in high-tension current-interrupting devices used where space is a factor is universally known, and the equipment of the modern central station usually contains evidence of the general approval of apparatus of this kind. Its reliability, small amount of attention required to keep it in order, compactness and consequent ease of installation give such apparatus an especial adaptability for use in many locations.

A new addition to the line of oil-immersed circuit-breaking apparatus manufactured by the Westinghouse Electric & Manufacturing Company, and designated as "Type D," is shown in the accompanying illustration. In a number of particulars it has no counterpart in other oil switches now on the market. It is made with two, three and four poles, single and double-throw, in all capacities up to and including 1,000 amp. and voltages up to 3,300. The ultimate breaking capacity is given at 600 kw for single-phase, 1,200 kw for two-phase, and 1,000 kw for three-phase.



FIGS. 1, 2, 3 AND 4.—OIL SWITCH.

Styles are made for wall mounting and for switchboard use, as illustrated. When used upon a switchboard, the switch is mounted upon the back of the panel, the handle projecting through to the front. The visible portions are finished in copper and dull black, in pleasing harmony, and forming an effective contrast with the marble panel. As regularly made, the switch is designed for use upon marble two inches thick, but by substituting shorter bolts it can be as easily mounted upon panels of lesser thickness. The handle of the double-throw switch is locked when the switch is open. Pressing upon a button in the end of the handle releases it and the circuit is closed by a pressure either up or down, the directions in which it is the easiest to apply force, and which cause the least strain upon the panel.

This type of oil switch is very generally used with motors, mounted upon an adjacent wall or post. It is one of the smallest oil switches made, and its size, compact form, ease of making connections, thorough insulation of connections when made, and facility with which the interior can be inspected give it a superior adaptability for use under the various conditions applying to such installations.

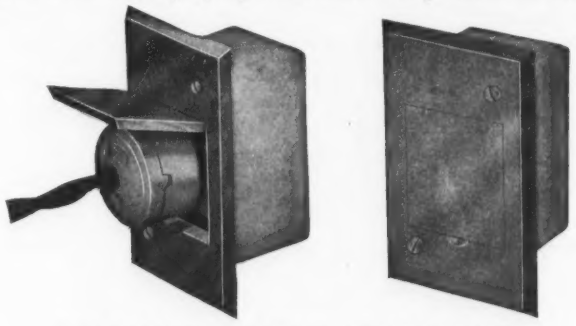
The mechanism is notable for its simplicity and efficiency. The design provides for the fewest possible number of links in the operating device. The switch is of the knife blade or jaw type, and gives a maximum amount of contact with a low temperature rise, which will not exceed 20° with a normal current. The final arc is taken upon an arcing tip, which is renewable. By this provision, no damage is done to the main contacts, and the life of the switch is prolonged indefinitely.

Surface and leakage distances have been carefully studied out and ample provision made. Contacts are thoroughly insulated. They are mounted on a wooden base suspended from the iron supporting frame, and at all times immersed in the oil. Each pole is isolated by a barrier of wood, which has been subjected to a treatment to give it high insulating qualities, and any possibility of communication of an arc between poles is thus avoided. The leads are brought out at the top, connections to the circuit being made inside the switch, and a porcelain insulator slipped over the joint. By this means all conductors are kept outside the oil tank.

The tank is of sheet metal, having a suitable insulating lining and is attached to the case by bolts. The lugs through which the bolts pass out sidewise, thus facilitating removal of the tank. The form of the tank, and the interposition of the wooden barriers between the poles, appreciably reduce the amount of oil required, and the danger of are slotted, and when the nuts are loosened the bolts can be lifted ignition during a fire. "Kilarc" oil is used, which is especially compounded for insulating purposes, and has a fire test of over 400° F. Its freedom from acidity and volatile matter give it high insulating properties, and make the evaporation low, while its viscosity renders it effective for extinguishing the arc.

Flush Wall Receptacle.

A flush pocket wall receptacle manufactured by the General Electric Company, of Schenectady, N. Y., and one offering many advantages, is shown in the accompanying illustration. It presents an attractive



FLUSH POCKET RECEPTACLES, OPEN AND CLOSED.

appearance, whether in use or not, and does not require a special attaching plug which could not be used in other sockets or receptacles in the same installation. It is a very handy device in connection with fan motors, desk lights, etc. The face-plate is of heavy brass having a polished nickel finish, other finishes being furnished when called for.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The market was strong and prices showed an advancing tendency. Standard stocks, like Pennsylvania, Union Pacific and issues of that character, together with the better class of industrials, were strong and active. The United States Steel stocks advanced under the influence of better reports regarding steel trade conditions, the preferred being particularly well bought, rising to 59; while the new 5 per cent. bonds went up to 75½. While sharing in the improvement, nothing of particular importance developed in the traction group apart from the decided strength of Interborough Rapid Transit, or Subway stock, in the curb market. Amalgamated Copper was quieter than usual, improving, however, on the announcement made on Thursday that the regular quarterly dividend of ½ per cent. had been declared. There was considerable selling activity in Brooklyn Rapid Transit, the total number of shares changing hands being 110,260. This stock closed at 50¼, thus gaining 1¾ points net. Metropolitan Street Railway made a net gain of 2 points, closing at 123; and Manhattan Elevated 2¾ points, the closing price being 145. The electrics showed strength under the influence of the improvement in the general market and General Electric made a net gain of 8¾ points, closing at 177¾. Westinghouse common was active, 7,900 shares being sold at prices ranging from 173⅞ to 167, the lowest, the closing figure being 172, which is a net gain of 4½ points. Westinghouse first preferred closed at the highest figure of the week—194—and gained 2⅞ points. Western Union remained about steady, closing at 88, and American Telegraph & Telephone closed at the highest figure of the week—128⅛—being a net gain of 2⅛ points. Following are the closing quotations of January 26:

NEW YORK.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Tel. & Cable	85	85	General Electric	174¼	175
American Tel. & Tel.	126	128⅛	Hudson River Tel.	..	..
American Dist. Tel.	22	22	Metropolitan St. Ry.	122⅛	122¼
Brooklyn Rapid Transit	50⅛	49⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	183	N. Y. & N. J. Tel.	..	147½
Electric Boat	18	18	Marconi Tel.	..	..
Electric Boat pfd.	45	46	Western Union Tel.	87⅞	88¾
Electric Lead Reduction.	1	⅝	Westinghouse com.	170⅛	171
Electric Vehicle.	8¾	10¾	Westinghouse pfd.	190	190
Electric Vehicle pfd.	14	14¼			

BOSTON.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Tel. & Tel	125¾	128¾	Western Tel. & Tel. pfd.	79½	82
Cumberland Telephone	*114½	112¼	Mexican Telephone	1¼	1⅜
Edison Elec. Illum.	230	235	New England Telephone	*122	121½
General Electric	174	176	Mass. Elec. Ry.	22	22¼
Western Tel. & Tel	8	10¼	Mass. Elec. Ry. pfd.	79	79

PHILADELPHIA.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
American Railways	43	45	Phila. Traction	..	87½
Elec. Storage Battery	58	59	Phila. Electric	6⅝	6⅝
Elec. Storage Battery pfd.	56	59	Phila. Rapid Trans.	8⅜	14⅜
Elec. Co. of America.	8⅛	8⅛			

CHICAGO.

	Jan. 19	Jan. 26		Jan. 19	Jan. 26
Central Union Tel.	..	..	National Carbon pfd.	93¾	95
Chicago Edison	..	..	Metropolitan Elev. com.	16	17⅛
Chicago City Ry	160	160	Union Traction	6¼	5¾
Chicago Tel. Co.	..	..	Union Traction pfd.	30	30
National Carbon	26	28			

*Asked

KEYSTONE TELEPHONE.—President John M. Mack, of the Keystone Telephone Company of New Jersey, makes the following annual report for the fiscal year ended December 31, 1903:

Assets:	
50,000 shares, being all of the common stock of Keystone Tel. Co. of Phila.	$4,433,712
2,500 first mortgage of the Keystone Tel. Co. of Phila.	2,500,000
Current assets	439,982
Taxes (prepaid)	2,408
Total	$7,376,102
Liabilities:	
100,000 shs. pfd. stk. (6% cumulative) @ $50 each (less unsubscribed)	$1,936,800
100,000 shs. com. @ $50 each, fully paid	5,000,000
Current liabilities	312,636
Accrued liabilities (interest)	8,150
Int. rec. in excess of int. pay. from Jan. 16, 1903, to Dec. 31, 1903	118,516
Total	$7,376,102

NEW YORK CONSOLIDATED GAS.—The surplus earnings of Consolidated Gas Company for the fiscal year ending December 31, 1903, after the payment of dividends, amounted to more than $2,500,000, as compared with $2,100,000 in 1902 and $1,500,000 in 1901. In the absence of President Gawtry, who was prevented from attending the annual meeting by illness, Vice-President Addicks made a statement regarding the operations during the past year. He pointed out that the company had difficulty in obtaining fuel early in the year, the scarcity caused by the anthracite strike in 1902 extending over to the early part of 1903. The output of gas and electricity, the surplus earnings, together with other operating statistics, compare with the preceding year as follows:

	1903.	1902.
Surplus earnings	$2,500,000	$2,100,000
Sales of gas (cubic feet)	20,227,832,000	18,358,478,000
Average candle power	23.97	24.27
Miles of mains	1,762	1,753
Services	188,973	198,637
Meters	580,287	556,063
Stoves, ranges sold and rented	36,208	42,632
Electric current sold, kilowatts	107,256,189	88,500,040
Electric customers gained	6,325	4,700
Expenditures in construction	$7,035,796	$5,022,987
Charged off for repairs	1,799,015	1,335,428
Charged off for depreciation	1,023,934	744,400
Charged off for taxes	1,727,372	1,755,685
Employes benefit societies	21,753	18,916
Coal and coke used, tons	1,029,433	947,053

CROCKER-WHEELER COMPANY.—The annual report of the Crocker-Wheeler Company, Ampere, N. J., for the year ending December 31, 1903, shows a decided gain over the preceding year. The results of the year's operation must be highly gratifying to the officers and stockholders, and it is certainly an encouraging showing for all interested in electrical development. While this company is widely known as one of the leading manufacturers of large generators and power motors, we think it will come as a surprise to those who have not followed closely the course of electrical development, to learn that last year its gross business amounted to more than two millions of dollars; in other words, it turned its capital over twice in twelve months. The gross profit for the year's operations was $519,781, and after paying fixed charges, dividends, reserves, etc., a balance was carried to surplus of $167,994, making the total surplus to date $408,868. At the time of the report orders amounting to more than a half million dollars were passing through the works, which, though recently enlarged, are now crowded to their capacity. President Wheeler, under whose able management this institution has grown up, is to be congratulated on this evidence of stability and prosperity.

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company is quoted as saying: "The Storage Battery Company made net earnings of more than 10 per cent. on its stock during 1903. The surplus will be substantially greater than that of the previous year, which was about $300,000. The company has all the work it can do. There is nothing to prevent our continuing to pay dividends as in the past. The Edison battery has not yet proved itself a factor in the market. The Electric Storage Battery Company has practically all the business in the United States. We are also getting our English company into good shape."

THE FALL RIVER AUTOMATIC TELEPHONE COMPANY has paid its fourth quarterly dividend at the rate of 5 per cent. per annum. It now has 1,160 stations, an increase of about 100 for the quarter. Although its toll rate to the New Bedford Automatic exchange is 10 cents, and the New England Telephone & Telegraph Company has reduced its rate from 15 cents to 5 cents between these points, the earnings of the Automatic Company's toll lines show a steady increase.

ILLINOIS TELEPHONE COMPANY SELLS OUT.—The Illinois Telephone and Telegraph Company, according to advices from Chicago, on January 18 filed a bill of sale of all its property, including tunnels, tracks, automatic switchboard appliances, telephone system, etc., to the Illinois Tunnel Company, which was recently chartered with a capital stock of $3,000,000.

AMERICAN TELEPHONE & TELEGRAPH.—The recent advance in American Telegraph & Cable stock to 86¼ on sales of 1,050 shares drew from President Clowry, of the Western Union, the following remark: "It is a 5 per cent. guaranteed stock, and I have wondered why it has not been quoted higher. The Western Union owns most of the stock."

STOREY RECEIVER DIVIDEND.—George R. Beach, of Jersey City, receiver for the Storey Motor and Electric Company of Harrison, N. J., has announced that he is ready to pay to his creditors a first dividend of 25 per cent. The proved claims against the company amount to $33,500.

NORTHERN OHIO TRACTION shows $882,276 gross for the year, net $399,701 and charges $268,132, leaving a surplus of $131,569.

CENTRAL UNION TELEPHONE.—The Central Union Telephone Company reports for the year ended December 31, 1903, an increase in surplus of $140,000. H. F. Hill has been added to the board. The following comment from Boston as to the outlook in the Central States will be of interest: "The reorganized Bell Telephone properties should do well upon their present basis of capitalization, which is far below the cost of duplication with all the water squeezed out. The Western Telephone Company properties allowing $8 for the common stock, $80 for the preferred and $100 for the bonds, sells at $24,080,000, or not much over $120 per subscriber, against $240 per subscriber for many of the Bell companies that have not been scaled down. The Michigan Telephone property, valued at $13,000,000 in the hands of its bondholders at about $5,500,000, $110 per subscriber, with constantly increasing earnings, will take care of itself in good shape. The Central Union Company capital was cut in two—that is, reduced from $6,000,000 to $3,000,000, increased again to $6,000,000 the Bell and a few stockholders putting in $3,000,000. It has already spent this new money and is a small borrower, and it has out $6,000,000 bonds. The company has not done as well as was expected on account of being in the hot-bed of competition, the Middle West." The Central Union Telephone Company reports as follows for the year ended December 31:

	1903.	1902.	1901.	1900.
Gross	$3,181,120	$3,003,717	$2,584,789	$2,309,471
Expenses	2,426,172	2,341,989	1,973,501	1,674,395
Net	$754,948	$661,728	$611,288	$635,076
Charges	438,796	481,383	386,762	317,567
Surplus	$316,152	$180,345	$224,526	$317,509

MARCONI WIRELESS REVENUES.—It is stated that at a recent meeting of the directors of the Marconi Wireless Telegraph Company of America, there was a lively discussion of questions involving the future policy of the company in its dealings with the English company. The traffic of the Marconi system has increased so rapidly, especially in the matter of dispatches originating abroad for delivery in the United States, that the existing conditions with respect to a distribution of the revenues are considered by the American interests to be inequitable. The English company insists that the basis of the original provision was upon a world-wide foundation, being of universal application to all Marconi companies wherever organized, and that though it appears inequitable at this time, owing to the fact that the foreign business has not yet developed equally with the American business, it will, in the end, prove to be as profitable an arrangement to the American company as to any other. The American company contends that the proportion is not as great as the superior progressiveness of the American people entitles it to receive, and it believes that in the end the arguments of the American interests will prevail and that a new arrangement will be perfected whereby a larger proportion of the earnings of the Marconi system will find its way into its coffers. This question has been under discussion for some time between the officers of the respective companies concerned, but was only recently brought to the attention of the directors.

TORONTO TROLLEYS ANNUAL REPORT.—The Toronto Street Railway reports as follows for the year ended December 31, 1903:

	1903.	1902.		Changes.
Gross	$2,172,087	$1,834,908	Inc.	$337,179
Expenses	1,200,823	1,015,361	Inc.	185,462
Net	$971,264	$819,547	Inc.	$151,717
Passengers carried	53,055,322	44,437,678	Inc.	8,613,644
Transfers	18,654,344	15,979,220	Inc.	2,680,124

After paying all charges and transferring $50,000 to the contingent account there remained a surplus of $180,638. Mr. J. C. Grace was added to the board of directors to take the place of Mr. James Ross, of Montreal, who resigned.

LIGHTING DEAL IN BALTIMORE.—A special telegram of January 18 from Baltimore, Md., says: "New York lighting interests, headed by Anthony N. Brady, were to-day given representation in the directory of the United Electric Light & Power Company. This is the company back of the scheme for utilizing the rapids of the Susquehanna River in the vicinity of Conewago for electric development. The four new members of the board, representing the New York interests, are Anthony N. Brady, his son, Nicholas F. Brady, Samuel A. Beardsley and Thomas E. Murray, all of New York. Mr. Murray is the general manager of the New York Lighting Companies controlled by the Brady syndicate. A. N. Brady is also made a member of the executive committee."

DIVIDENDS.—The American District Telegraph Company, of New Jersey, will pay a quarterly dividend of 1 per cent. on its capital stock January 22. This is a reduction of ¼ of 1 per cent. from the previous payment. The Western Telegraph & Telephone Company has declared a regular semi-annual dividend of $2 per share on the preferred stock, payable February 1, to stockholders of record January 22. National Carbon directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15. American Graphophone directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15.

Commercial Intelligence.

THE WEEK IN TRADE.—The conditions everywhere are extremely favorable, and optimism prevails in regard to the outlook for spring business. There is an enlarging volume of business at Southern and Southwestern markets and an awakening of interest at some Northwestern centres and growth at Central Western and Eastern markets. At the South there is confidence, based on the high price for cotton. Preparations for an enormous acreage are going forward. Chicago reports spring trade not yet opened, but signs of life are apparent. The iron trade is irregular as a whole, and variously regarded, according as the point of view shifts from crude to finished products, or the observer is located East or West. The lighter finished products of iron and steel are, however, in pretty good shape, and demand is higher. There is a better feeling in hardware, and in heavy structural steel and rails more talk of business is heard, although it is said that the railroads are rather backward in placing orders. Lumber and building materials are quiet and there is a promising outlook for spring business. In the metals, copper and tin are lower, while lead is higher. Copper was very quiet, and the demand was light. Exports continue on a large scale, at the present time amounting to 15,500 tons for the month, and it is estimated that the total of the entire month will foot up about 20,000 tons. Closing quotations were 12¾c. for Lake, 12⅝c. for electrolytic and 12¼c. for casting stock. It is said that a large German house made an offer to the United Metals Selling Company for 50,000,000 lbs., which was readily accepted, and shipments on this order are being made with equal promptness. *Bradstreet's* reports 266 business failures during the week ended January 21, as against 315 the week previous and 253 the corresponding week last year. About 87 per cent. of the failures had capital of $5,000 or less, and 9 per cent. at from $9,000 to $20,000 capital.

ELECTRICAL PARTS IMPORTED.—United States General Appraiser Israel F. Fischer has handed down a decision on the classification of so-called stamped steel shapes, which are used in the construction of electrical machines. Some of them are plain and others coated on one side with a preparation of flour paste and talcum, which serves to insulate them. Both were assessed at 45 per cent. as manufactures of metal, and the importers, Thomas Meadows & Co., of New York, claimed that they should be classified as "steel not specially provided for" at 1 3/10 cent a pound. This claim was allowed on the uncoated plates, but on the others Mr. Fischer ruled that the coating had so changed their character as to make the claim untenable.

FIVE THOUSAND H.P. EQUIPMENT FOR SYDNEY.—Contracts have at last been awarded for some of the further equipment to be installed in the power station of the Sydney City and Suburban Tramways. This system is being considerably extended by the New South Wales Government. About 70 miles are already in operation. The existing equipment of the power house includes General Electric generators, Allis engines and Babcock & Wilcox boilers. The boilers for the additional installation of 5,000 hp. will also be of Babcock & Wilcox build. The heaters have been ordered from the Joubert Manufacturing Company. The electrical machinery is expected to be contracted for very shortly.

FIRE IN E. W. BLISS COMPANY'S FACTORY.—On Friday afternoon, January 22, fire at the main works of the E. W. Bliss Company, in Brooklyn, destroyed property valued at $250,000. The fire was confined to the new section of the plant, which was six stories in height. The officers of the Bliss Company state that the loss is fully covered by insurance. There were 1,500 employees in the factory at the time, but they all escaped unhurt. A sad feature of the fire was the killing of Lieut. Gibson, of one of the fire companies, who fell from a ladder, 60 feet, and was impaled on a hook on the fire truck. The hook penetrated Gibson's heart, causing death in a few minutes.

MEXICAN HYDRAULIC PROJECT.—The construction of a hydraulic plant is contemplated on the River Grande de Santiago, in the municipality of Hostotipaquillo, Canton of Ahualulco, State of Jalisco, Mexico. The necessary concession has been secured from the Mexican Government by F. Brennan, of Mexico City. The franchise permits of the utilization of 15,000 liters of water per second.

SHIPMENTS OF FRANCKE ENGINES.—The Maxfield-Francke Company, of 120 Liberty Street, New York, reports the following shipments of the Francke Four-Ported engine: Under-Feed Stoker Company of America, Chicago, Ill., first order 7 x 6 engine, direct-connected to steel plate forced-draft blower. Struthers-Wells Company, Warren, Pa., 7 x 6 engine, for operating mechanical stoker. James Beggs & Co., New York, 4 x 3½ engine for operating mechanical stoker. Mershon Patent Shaking Grate Works, Philadelphia, Pa., 5 x 4 engine for operating disc ventilating fan. M. A. Hicks, Springfield, Vt., 4 x 3½ engine for driving dynamo. Under-Feed Stoker Company of America, Chicago, Ill., second order 5 x 4 engine, direct-connected to steel plate forced-draft blower. Iowa Heat, Light & Power Company, Des Moines, Iowa, 7 x 6 engine direct-connected to centrifugal pump. Linn Woolen Mills, Hartland, Me., 5 x 4 engine, direct-connected to steel plate blower. Lever Bros.' Soap Works, Cambridge, Mass., 7 x 6 engine for operating mechanical stoker. Robert Dobson Co., Pittsfield, Me., 7 x 6 engine, direct-connected to steel plate blower. McClave-Brooks Co., Scranton, Pa., 4 x 3½ engine for operating mechanical stoker. George Bowen, South Charleston, N. H., 4 x 3½ engine for driving dynamo. McMurtrie-Guiler Co., New York, 5 x 4 engine, direct-connected to centrifugal pump for export to Porto Rico. Iowa Heat, Light & Power Company, Des Moines, Iowa, second order 5 x 4 engine, direct-connected to centrifugal pump. Northern Engineering Company, New York, 4 x 3½ engine for driving dynamo. J. Heidingsfeld, New Brunswick, N. J., 5 x 4 engine for running printing plant. In addition to the above list, they have several different makes of generators at the works, for which engines are almost ready for direct-connecting, and which will be shipped to various points in the United States at an early date. Some of these engines are operating as low as 100 r.p.m., while others operate at all intermediate speeds up to as high as 800 r.p.m.

BARB WIRE TELEPHONE DEAL.—It is stated that a merger of two telephone lines owned and operated by farmers in Washington State has been made, and that there are prospects that all rural lines centering in or around Pullman in Eastern Washington will be consolidated. There are fully three hundred miles of rural telephone lines constructed and operated on the coöperative plan by farmers in the vicinity of Pullman. The central station is maintained there, with Lewis L. Wright as manager. Wright owns the central station and several rural lines, and all lines are connected with his station, where an operator connects each line with any other line over which it is desired to converse. For this service, "central" charges 35 cents per telephone per month. The merger price will be 40 cents. Fully two hundred families living on farms have telephone connections in this way, and the system has proven a great luxury to the wives of the farmers, as well as a convenience to the farmers themselves. These telephone systems are the outgrowth of the barbed-wire telephone system built by J. S. and J. M. Klemgard and J. L. Metsker, four years ago.

THE HOLTON POWER COMPANY, Holton, Cal., is developing water power on the large Imperial irrigating canal, and will sell electricity for light, heat and power. An electric railway to Imperial, 12 miles distant, is also being built. About 650 hp. will be developed at first, and the station will have an ultimate capacity of 1,500 to 2,000 hp. When it is considered that this canal and the power development are about 200 ft. below sea level, considerable interest attaches to the project. Another interesting feature is that quite a market is anticipated for electric heat for cooking and household purposes. Coal sells as high as $18 a ton at Holton. Wood is correspondingly high, and it is said that electricity can be sold for heating and cooking at a cost not to exceed 1¼ times the cost of gasoline, with, of course, greater convenience and cleanliness. Samuel Starrow, of Los Angeles, is consulting as well as constructing engineer for the Holton Power Company.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended December 20 and since December 20 compares with the month ended December 20 and the period from December 20 in previous years as follows:

	1903.	1902.	1901.
Gross output	88,947	92,732	63,196
Returned	39,678	34,688	23,593
Net output	49,269	58,044	39,603
Since Dec. 20:			
Gross output	1,109,888	960,055	683,955
Returned	480,691	386,861	311,645
Net output	629,197	573,194	372,311
Total outstanding	3,779,517	2,526,010	1,952,816

MORE EQUIPMENT FOR MANILA.—The Manila Electric Railroad & Light Company has just placed some further contracts through J. G. White & Co., 49 Exchange Place, New York, for equipment to be installed in the power house, to be erected in Manila, Philippine Islands, for electric traction and lighting. The Alberger Condenser Company, 95 Liberty Street, New York, has taken the contract for the condensers, which will consist of a high vacuum surface condensing equipment to take care of each of the three 700-kw Westinghouse turbine units. The condensers will operate on the counter current dry system. The United States Steel Products Export Company, which concern was recently formed to handle the foreign trade of the United States Steel Corporation, has been awarded the contract for the steel.

THE BROWNLOW BILL.—There is a strong sentiment apparently throughout the country in favor of the new Brownlow Bill now pending in Congress, which appropriates $24,000,000 as national aid for the building of wagon roads. This money is to be distributed according to the population of each of the States, except that the States having less than 700,000 people are to receive a minimum amount of $250,000. Each State, county or town receiving national aid must add a like amount. This bill will result in the spending of $48,000,000 for the building of wagon roads and will build from 100 to 500 miles of good road in every State of the Union. Such roads would be a universal boon.

ALUMINUM CIRCUITS.—It is stated that within a year the Boston Edison Electric Illuminating Co. has purchased 298,245 pounds of aluminum wire, which represent a total of 246 miles. The Massachusetts Electric Company has purchased about 500,000 pounds as a substitute for copper. The Boston & Maine Railroad, the Tucker, Anthony & Company properties, Hartford Electric Light and the New Milford (Conn.) Power Company have all placed large orders for aluminum wire. The Lewiston & Auburn Electric Light Company also has equipped its lines with aluminum.

IMPORTED ELECTRICAL SCARF PINS.—United States General Appraiser Thaddeus S. Sharretts has overruled a protest by the American Electrical Novelty Company of New York against the assessment of 60 per cent. duty on jewelry on parts of electrical scarf pins. The articles consisted of eight imitation diamonds set in base metal. The importers claimed that they were dutiable at 45 per cent. as manufactures of metal, glass, or paste. Gen. Sharretts overruled these claims on the ground that they were components of articles generally known as jewelry.

NORTHERN CALIFORNIA POWER.—In 1901 the Northern California Power Company contracted for three Pelton water wheel units, each 1,600-hp capacity, operating under a head of 1,150 ft., for its electric transmission plant on Battle Creek, a few miles from Anderson, Cal. In 1902 the Pelton Company received an additional order for two 3,000-hp units, operating under the same head. The Northern California Power Company furnishes electricity for power and lights for all the important mining and farming towns within a distance of 80 miles of its plant.

WILLARD STORAGE BATTERIES.—The Willard Storage Battery Company, Cleveland, Ohio, the well-known manufacturer of storage batteries, has moved into larger quarters at Twenty-seventh and Clair Streets. It will install 200 hp of boilers and engines and two 75-kw generators for lighting and power. It will buy considerable new machine tool equipment and will install a complete wood-working equipment for manufacturing its own battery cases. Mr. T. A. Willard is general manager of the concern.

CALIFORNIA POWER TRANSMISSION.—A very important installation of Pelton water wheels was recently completed near Placerville, Cal., for the American River Electric Company, consisting of two double Pelton units of a capacity of 2,500 hp, operating under a head of 575 ft. This concern is situated on the American River, within a few miles of the state capital, Sacramento, and will generate electricity for near-by towns.

POWER TRANSMISSION IN CALIFORNIA.—Poles and wire have been bought for the Temescal Water Company's 30-mile transmission line in California from its electric power plant at Ethanac to the wells in the Temescal basin. At a regular meeting of the company's board of directors, President F. F. Chase was authorized to select a superintendent to succeed A. C. Miller, resigned.

EQUIPMENT FOR RUSSIA.—M. Gradstone & Company, 2 and 4 Stone Street, New York, who conduct an extensive export trade with Russia exclusively, have received some large inquiries for various electric traction and lighting equipment.

OMAHA POWER HOUSE.—General Manager Smith, of the Omaha-Council Bluffs Street Railway Company, has announced that the new power house capable of generating 6,000 hp., will be completed at a cost of $500,000.

BAKER PLATINUM.—Since January 1, the well-known platinum house of Baker & Company has become Baker & Company, Incorporated, with C. O. Baker as president, and C. W. Baker as vice-president and treasurer.

BALL ENGINE ORDERS.—The South Dakota Agricultural College, of Brookings, S. D., has recently purchased an automatic engine from the Ball Engine Company, Erie, Pa.

General News.

THE TELEPHONE.

DENVER, COL.—The Washington County Telephone Company, with a capital stock of $5000, has been incorporated by H. W. Twombly, C. D. Pickett and M. H. Spere, Akron, Col.

CENTER POINT, IND.—The Center Point Telephone Company has been incorporated with a capital stock of $5000. The directors are H. F. Weber, L. Lansit and others.

INDIANAPOLIS, IND.—The New Long-Distance Telephone Company has paid its regular quarterly dividend of 1 per cent. The company is planning numerous extensions to be made during the summer.

DUNKIRK, IND.—Ed. V. Fitzpatrick, a resident of Portland, has secured a controlling interest in the Citizens Telephone Company, of this city, and has succeeded in electing a board of directors of his choice. The action has displeased the stockholders.

INDIANAPOLIS, IND.—The West Fork & Sulphur Home Telephone Company has filed articles of incorporation with the Secretary of State. The company has a capital of $4000. The principal exchange will be in West Fork. George F. Dewett is president.

SILVER LAKE, IND.—The stockholders of the People's Mutual Telephone Company have elected H. L. Oldfather, Arthur Smith and Amar N. Igo, directors. The company now has 525 telephones and 90 miles of toll lines. Last year 184 telephones were installed.

CRAIGSVILLE, IND.—The people of Craigsville are clamoring for a better telephone service from that which is now furnished them by the Bell Company, which they say is not sufficient to satisfy their needs. The Bell is not an all night service. A movement is on foot to get the United Telephone Company to run a line to Craigsville.

MUNCIE, IND.—The Central Union Telephone Company has decided to expend $50,000 in improving and extending its service in Muncie and Delaware Counties. This is made necessary, it is said, by the competition of the Delaware & Madison Counties' Telephone Company which recently expended a large sum in completing a new plant here and which is giving excellent service over a wide territory.

INDIANAPOLIS, IND.—The ten-party lines of the Central Union Telephone Company in this city, are to be replaced as rapidly as possible by a four-party line system. The ten-party line subscribers paid $1 a month. The four-party line service will cost $1.25. More than $30,000 will be spent by the company during January in new switchboards and dynamos for the central plant. A new switchboard will also be placed in the exchange at Irvington.

GENESEE, IDA.—At a meeting of citizens held here recently, it was decided to organize and operate a local and rural telephone system.

ESTHERVILLE, IA.—The citizens of this place have asked the council for a telephone franchise.

HUDSON, IA.—The Hudson Mutual Telephone Company is the name of a new company just organized here with H. B. Eighmey as president.

HAMILTON, MONT.—The Bitter Root Telephone Company will extend its system as far as Darby. The line will also connect with the logging camps of the Anaconda Copper Mining Company.

ST. JOSEPH, MO.—The Board of Public Works proposes to have all telephone and telegraph wires within the business district of this city placed in underground conduits. The cost of the work will be about $500,000. The matter is in the hands of City Electrician Floyd and an ordinance will soon be drawn up.

SEDALIA, MO.—The strike of the Missouri & Kansas Telephone Company linemen has been settled. A nine-hour day instead of ten hours, and an increase in pay from $2.25 to $2.40 a day were granted. The men asked for $2.50 per day; one and one-half pay for overtime and double pay for Sundays and legal holidays.

RENO, NEV.—A representative of the Automatic Telephone Company has been here looking into the feasibility of establishing a system here and at adjacent points.

LANCASTER, N. Y.—The Bell Telephone Company has applied to the village authorities for a franchise.

RIVERHEAD, L. I., N. Y.—Th Baiting Hollow & Roanoke Telephone Company of this town has increased its capital stock from $5000 to $20,000.

ROME, N. Y.—At the annual meeting of the Rome Home Telephone Company Mr. Fred M. Shelley was re-elected president; John S. Wardwell, vice-president, and D. Odell, secretary, treasurer and manager. The business of the company has increased rapidly and now over 1000 telephones are in service. When the business was first started provision was made for an exchange for 500 telephones.

SALISBURY, N. C.—The Southern Bell Telephone Company has bought the local exchanges at Salisbury and at Spencer, N. C., and it is said that improvements will be made. The transfer of the franchises seems to meet with public favor.

RANDLEMAN, N. C.—The Randleman Telephone Company has been chartered by the Secretary of State with $5000 authorized capital stock and $3000 paid in. S. Bryant, T. E. Marshall, Jr., and H. O. Barber, all of Randleman, are the incorporators.

PAINESVILLE, OHIO.—The Bell Telephone Company is planning to spend $15,000 in improving its plant here.

FINDLAY, OHIO.—The Central Union Telephone Company is preparing to make important improvements at its Findlay exchange.

GARRETTSVILLE, OHIO.—The Portage County Telephone Company has erected a new line from Garrettsville to Parkman and is projecting other extensions.

TOLEDO, OHIO.—The Central Union Telephone Company states that it has added 1200 new subscribers to its service since the issue of its last telephone list.

WEST UNION, OHIO.—The Central Union Telephone Company has just completed a line from North Liberty to West Union and will build a new line to Eckmansville.

BRUNSWICK, OHIO.—The Brunswick Independent Telephone Company has been incorporated with a capital stock of $5000. The directors are M. J. Hawkins, A. D. Alyard and others.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has recently erected a number of farmers' lines and the service is proving so popular that other farmers' lines are to be built throughout the entire district.

IRONTON, OHIO.—The Ohio Valley Telephone Company, capital stock $2000, has been organized by H. P. Gerlach and others of Ironton. The company will build an exchange at Proctorville, Ohio.

BEALLSVILLE, OHIO.—The White Telephone Company is preparing to extend its lines to Woodsfield and Cameron. Connection with the long-distance system of the United States Telephone Company will be made at Bellaire.

AKRON, OHIO.—James B. Douglas, manager of the Alliance exchange of the Central Union Telephone Company has been made manager of the Akron exchange of the company. Extensive improvements are to be made at Akron.

KIRTLAND, OHIO.—The Kirtland Telephone Company has been organized by A. G. Tyron, Henry Hooper, W. R. Creary, W. A. Criswell and I. A. Harris. Capital $2,500. The company will build a local system in Kirtland and vicinity.

AKRON, OHIO.—The Summit Rural Telephone Company has organized with W. F. Laubach, president and general manager; E. A. Hawkins, secretary, and H. C. Spicer, treasurer. The company recently built lines to Ghent, Wordon, Montrose and Hammond.

LORAIN, OHIO.—The mayor has vetoed a franchise application made by the Bell Telephone Company and the latter will appeal to the Probate Court. The Black River Telephone Company, the independent company, is endeavoring to block the entrance of the Bell Company.

MANSFIELD, OHIO.—The Mansfield Telephone Company has elected the following-named officers: S. N. Ford, president; J. L. Baxter, vice-president; M. D. Ward, secretary-treasurer. The company enjoyed much prosperity last year and is planning to make improvements this spring.

WADSWORTH, OHIO.—The Wadsworth General Electric Company contemplates building a six-mile party line. It has 200 subscribers, 40 of which were added last year. The company uses North Electric apparatus and charges $10 a year for residence service and $15 for business.

MARTINS FERRY, OHIO.—The Bell Telephone Company has perfected an arrangement with farmers in this vicinity whereby if they secure a certain number of subscribers and erect their own pole lines the company will supply telephone service at a low price. Connection is made with the Martins Ferry exchange.

BRILLIANT, OHIO.—The Ohio Valley Telephone Company, of Brilliant, has organized with Robert Carpenter, president, and J. G. Gilchrist, secretary. The company will build lines along the river front in Jefferson County and will connect up all the independent companies in that vicinity. A large number of lines will be built at once.

SHEAKLEYVILLE, PA.—The Sheakleyville Telephone Company has been organized with H. Orr as president.

YORK, PA.—The stockholders of the York Telephone Company held their annual meeting recently and elected directors, who elected officers as follows: President, D. F. Lafean; vice-president, John McCoy; secretary, H. H. Weber; treasurer, C. C. Frick. The board of directors recently declared a dividend of 2 per cent on the stock.

CUMBERLAND GAP, TENN.—The Cumberland Gap Telephone Company has been incorporated with a capital stock of $10,000. The directors are G. W. Fortune, J. H. Quillen and others.

EL PASO, TEX.—The Southwestern Telegraph & Telephone Company has purchased a site here for its proposed telephone exchange building and the contract will soon be let for its construction.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has been granted a franchise by the county commissioners to extend its lines through the county.

PULLMAN, WASH.—A consolidation of all the rural telephone lines owned by farmers in the vicinity of this city has been effected. These lines are about 300 miles in extent.

ADAMS, WIS.—The Adams Telephone Company has been incorporated with a capital of $2000. The directors are Christ Reuben Garrison and others.

NEW LONDON, WIS.—The Wisconsin Telephone Company is making arrangements to build an exchange here.

WASHBURN, WIS.—The Bayfield County Telephone Company has been engaged in extending its lines to Bayfield and Houghton, and expects to complete the new line this month. This will give the company toll line facilities to all points on Chequamegon Bay to points along the Wisconsin Central Railroad and to Superior and Duluth.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has just inaugurated service on a new toll line between Abbottsford and Ashland, a distance of 120 miles. During the past year the company has strung 16000 miles of copper wire. Seven telephone exchanges were built and in a number of other exchanges new equipment was installed. The company gained 9500 new subscribers, of which 2500 are in Milwaukee.

ELECTRIC LIGHT AND POWER.

SAN PEDRO, CAL.—The City Trustees have instructed the City Attorney to prepare an ordinance calling for a special bond election for the construction of a municipal lighting plant.

LOS ANGELES, CAL.—J. L. Campbell, of San Bernardino, has submitted a proposition for furnishing this city with electricity. The cost to the city of putting in the plant is placed at $63,000.

CRIPPLE CREEK, COL.—Mayor Schockey advises that arrangements be made at once for the construction of an electric light plant, to cost about $50,000. A committee has been appointed to investigate the matter.

GLASTONBURY, CONN.—L. W. Ripley, of Hartford, is contemplating the erection of a hydro-electric plant at Glastonbury. It is proposed to install four alternating-current generators varying from 50 to 300-kw. These will be driven by probably three wheels, either turbines or of the impulse type, with an auxiliary engine of about 250-hp. It is proposed to build one dam probably of concrete about 115 feet high and 230 feet long, and another dam for storage purposes probably of earth and masonry combined, about 35 feet high and 400 feet long. The power will be used for lighting, for manufacturing purposes and for street railway work. No contracts have been placed as yet.

TAMPA, FLA.—The Tampa Electric Company has decided to proceed at once with the construction of a power house at the mouth of Hillsborough River, to cost about $100,000. Mr. Wells is manager.

CONYERS, GA.—The citizens have voted to issue $10,000 bonds for the construction of an electric light plant.

SAVANNAH, GA.—The Savannah Electric Company has under consideration the extension of its system to Tybee, Ga.

SAVANNAH, GA.—The Director of Public Works, in his annual report, recommends the municipal ownership of an electric lighting plant.

ATLANTA, GA.—The Board of Electrical Control has granted the Georgia Railway & Electric Company permission to lay conduits for the purpose of bringing current from the Bull Sluice plant into the city.

KANKAKEE, ILL.—The Kankakee Electric Light & Power Company will construct a concrete dam here this year to cost about $15,000.

BELLEVILLE, ILL.—The stockholders of the Belleville Gas & Electric Company have elected L. D. Turner, Edward Abend, Henry A. Kircher, George Gauss, M. M. Stephens, R. D. W. Holder and Charles Becker directors for the ensuing year.

ROCK ISLAND, ILL.—There is reported to be a movement on foot here to harness the Mississippi Rapids and use the water power. It is proposed to build a dike 500 feet from the north shore 20 miles up the river and get a 15-foot fall which will develop 20,000 horse-power. Congressman Lorimer is reported to have been here in the interest of the matter.

AURORA, IND.—The city of Aurora wants bids for lighting the city with 75 arcs, as well as incandescent lamps for private consumers. Mr. Eugene Severin is the city clerk.

COLUMBUS, IND.—The General Electric Company is stated to have secured the contract for the electric light plant for $7,033. An engine will now be purchased in open market.

INDIANAPOLIS, IND.—David Wallace, of the Board of Public Works, is interested in a plan to furnish Indianapolis with electric power by building a dam across Eel River in Owen County.

CHICKASHA, IND. TER.—Jas. W. Hockaday, manager of the Chickasha electric light plant, states that from $10,000 to $12,500 will be expended by the company for new machinery.

DAVENPORT, IA.—The Davenport Water Power Company has been formed by F. H. Griggs, Charles Ainley and others to build a canal and develop water power from the Mississippi River.

IOWA CITY, IA.—The Board of Regents of the State University will ask the Legislature for an appropriation of $25,000 to construct a dam below the University grounds to furnish power for the heating and electric plants.

WINFIELD, KAN.—The citizens have voted to issue $134,000 water and lighting bonds.

TOPEKA, KAN.—The City Council is considering the question of making improvements to the electric light plant. E. B. Snyder is chairman of the electric light committee.

LEXINGTON, KY.—W. H. McCorkle is seeking a franchise for an electric light plant.

NEWPORT, KY.—Mayor Helmbold in his message to Council advises a municipal electric light plant.

NEW ORLEANS, LA.—It is reoprted to be the intention of the Consumers' Electric Company to construct an extensive electric plant. Jules Dreyfous is President.

BATON ROUGE, LA.—The Baton Rouge Electric & Gas Company during the next three months will place contracts for a 150-kw, 550-650-volt generator, and a 400-hp steam or gas engine; if the latter, a producer plant also.

BAY CITY, MICH.—The Council has adopted an ordinance providing for the establishment of a municipal light plant.

MARQUETTE, MICH.—The Electric Light and Power Commission has decided to employ a hydraulic engineer with regard to the enlargement of the electric light plant.

AGRICULTURAL COLLEGE, MICH.—Bids are wanted Feb. 3 for constructing a central power house and coal shed at the Agricultural College. Address A. M. Brown, Secretary State Board of Agriculture.

MONTEVIDEO, MINN.—The Montevideo Electric Light & Power Company has secured water rights at Minnesota Falls, and proposes to construct a dam and develop power.

MINNEAPOLIS, MINN.—F. W. Cappelen, City Engineer, has submitted a report to the special council committee on the General Electric Company's franchise. He estimates that the cost of a plant with 1000 arc lights, with a relay capacity of 33 per cent., the lamps to be lighted 3500 hours, or according to the all-night system, at $512,646, provided the plant is located on property already belonging to city; of this the conduit system would require $266,774, the overhead system $105,477, the electrical equipment $37,475; steam equipment, $58,200, and building, $32,000. The cost of operation would be about $87,379 per year.

CANTON, MO.—Bids are wanted Feb. 3 for constructing an electric light plant.

HANNIBAL, MO.—The proposition to issue bonds in the sum of $100,000 to rebuild the municipal electric light plant at this place was carried at the special election held January 11.

GALLUP, N. M.—The Gallup Electric Light Company has been incorporated by Maynard Gunsul and Herbert F. Raynolds, of Albuquerque, and Kenneth K. Scott, of Gallup, with a capital of $50,000.

ITHACA, N. Y.—The matter of placing the electric wires underground is under consideration.

GLENS FALLS, N. Y.—The Village Trustees are considering the application of Frank H. Deal, of Troy, for an exclusive franchise to maintain an underground conduit system.

SCOTTSVILLE, N. Y.—The Wheatland Power Company, of Scottsville, has been incorporated with a capital of $20,000. Directors: I. W. Salverds, of Scottsville; M. E. Lewis and H. C. Brewster, of Rochester.

GRANVILLE, N. Y.—The Granville Electric Light & Gas Co. is reported to have acquired water rights at outlet of Lake Saint Catherine near Granville. It is the purpose to dam the lake and use the fall to generate electricity for lighting and power. F. D. Pember is president.

POMEROY, OHIO.—Bids are wanted Feb. 2 for $18,929 bonds, $4466 to be used for lighting purposes. Abe A. Massar is village clerk.

WILLIAMSBURG, OHIO.—This town will sell at private sale $12,000 electric light and town hall bonds. Chas. Hoffman is village clerk.

WILMINGTON, OHIO.—The Wilmington, Water & Light Company has been organized under the laws of New Jersey to establish a lighting plant in Wilmington.

MONROEVILLE, OHIO.—The financial condition of the municipal lighting plant is in bad shape and in consequence the arc lighting department of the plant has been closed down, leaving the town in darkness.

CINCINNATI, OHIO.—The Hamilton-Otto Company will spend $200,000 in improvements to its electric lighting plant. It is the intention to install sufficient equipment to provide for handling both the lighing and street railway systems in Hamilton if necessary.

COLUMBUS, OHIO.—An ordinance is to be introduced in the council to regulate the price of electricity for lighting furnished by all the companies operating in the city. It is proposed to make the limit 7 cents per kilowatt. At present some of the companies are charging 12½ cents.

XENIA. OHIO.—D. M. Stewart and Charles Darlington, of Xenia, have had estimates prepared on the cost of a lighting plant of sufficient size to illuminate the city and furnish power for general lighting and manufacturing purposes. They are organizing a company for the purpose of erecting a plant.

WILKESBARRE, PA.—The Council has granted the Ashley Electric Company a franchise to furnish light in this city.

BRADDOCK, PA.—The Council has provided for the appointment of a committee to inquire into the cost of an electric light plant.

MAHANOY CITY, PA.—The People's Light, Heat & Power Company, of Mahanoy Township, has been organized with D. M. Graham, president, and A. B. Carney, secretary.

SELINSGROVE, PA.—The Borough Council has decided to accept a proposition from Mr. Callahan, of Sunbury, to light the town with electricity. The plant will be installed here at once.

ELLWOOD CITY, PA.—It is stated that the Manufacturers' Light & Heat Company, of Pittsburg, will, during the year, make extensive improvements on the lines of its Ellwood City division.

PHILADELPHIA, PA.—The Department of Health has approved plans for a light, heat and power plant for the Municipal Hospital, to cost about $125,000. Geo. W. Sunderland is assistant director.

NEW CASTLE, PA.—Wylie McCaslin, chairman of the Police Committee, has been instructed to procure the services of an electrical engineer to give estimates as to the cost of construction and operation of a municipal electric light plant.

ALLENTOWN, PA.—In his annual message to City Councils, Mayor Lewis advocates the installation of municipal electric light plant. The city is now paying to the Allentown Electric Light & Power Company over $20,000 a year for street lighting, and it is claimed that a municipal plant could be installed by the city at a cost much less than that. The Mayor's idea is to operate the lighting plant in conjunction with the pumping station.

SCRANTON, PA.—The Delaware, Lackawanna & Western Railroad Company has just completed a big power plant at the Hampton mine in the Keyser Valley. The plant is equipped with 15 Babcock & Wilcox water-tube boilers of 325 hp each, which evaporate 400,000 gallons of water per day on a consumption of 175 tons of coal. The electrical equipment will include five 500-kw Curtis turbo-generators, two of which are now in operation. Electrical energy will be transmitted at 2300 volts (alternating current) to various mines owned by the company, where it will be transformed into direct current at a lower voltage by means of rotary converters. The power is used for lighting and power purposes at the mines.

AIKEN, S. C.—The Board of Directors of the Carolina Light & Power Company has authorized W. E. Moore, of McConnellsville, Pa., to negotiate for a $20,000 turbine plant for the local electric light system. Mr. Moore is now in New York for the purpose.

WATERTOWN, TENN.—Prominent business men here are reported to be discussing the construction of an electric light plant.

McGREGOR, TEX.—The power house of the McGregor water and electric light plant has been destroyed by fire.

WACO, TEX.—The City Council is considering the employing of an expert to make an estimate of cost of a municipal electric light plant.

DALLAS, TEX.—A resolution has been passed in Council and referred to Committee with instructions to investigate the advisability of constructing a municipal electric light plant.

SALT LAKE CITY, UTAH.—Among the improvements contemplated by the new Utah Light & Railway Company is the construction of a reserve steam plant, which will cost about $250,000.

DAYTON, WASH.—Jas. A. Ralph and Nicholas Codd have purchased the electric light plant here for $40,000.

EVERETT, WASH.—The Everett Development Company has begun work on a water and electric plant on May Creek. There is a head of 2000 feet, and about 10,000 horse-power will be developed.

OLYMPIA, WASH.—The Olympia Light & Power Company has executed a mortgage for $100,000 in favor of the American Loan & Trust Company, of Boston. The money is to be used in the enlargement and improvement of its works and equipment.

SHINNSTON, W. VA.—The Shinnston Light & Water Co., has been incorporated with a capital of $10,000. L. J. Howard is one of the incorporators.

RICHWOOD, W. VA.—The Richwood Light & Power Company, of Richwood, has been formed with $25,000 capital, by Richard M. Dyer, M. E. Dyer, of Cumberland, Md.; P. J. Dyer, of Weston, W. Va., and others, to construct an electric light and ice plant.

SHELL LAKE, WIS.—This city is considering the construction of water works and an electric light plant.

EAU CLAIRE, WIS.—It is reported that the Council will consider the feasibility of a municipal lighting plant.

ELKHART LAKE, WIS.—The electric light plant which has been idle for the last three months has been purchased and put in operation by Dr. Brickbauer.

PORTAGE, WIS.—It is stated that the Chicago, Milwaukee & St. Paul road will put in an electric light plant and pumping station of its own in this city. The road objects to the price it is paying for light and water.

FT. D. A. RUSSELL, WYO.—Bids are wanted Feb. 13 for lighting the Post here by electricity, including wiring of buildings and grounds, furnishing and installing fixtures, arc lights, etc., and necessary electrical current. Address Capt. W. S. Scott, Q. M., U. S. A., Cheyenne.

CATORCE, MEX.—An electric light plant is to be installed at the Dolores Trompeta mine, situated in this district.

CITY OF MEXICO, MEX.—The city council has appropriated $348,000 for providing the city with electric lights during the year 1904.

LA PIEDAD, MEX.—Jesus Avalos will soon commence the construction of a large electric power plant on the Lorma River, near here. He proposes to provide electric lights and power for several towns in this section and to furnish power for the operation of manufacturing concerns.

WOODSTOCK, ONT.—The citizens have voted to issue $25,000 bonds for improvements to the lighting plant.

OTTAWA, ONT.—A deputation representing the large electrical interests of Niagara Falls has interviewed the Ontario Government with a view of obtaining permission to export electrical energy from Canada to the United States. The International Railway Company, which includes the Gorge line and the Niagara Falls Park & River line, has not sufficient power, and its representatives desire that the Canadian power companies shall have the right to export power. It was, however, thought doubtful whether the government, under the Constitution, could allow the exportation of power and the matter has been taken under advisement.

OTTAWA, ONT.—The Ontario government has obtained information from provincial cities, towns and villages regarding municipalities conducting reproductive undertakings, covering a period of 1898 to 1902. The electrical statistics compiled from the returns sent in, show that electric lighting was a losing business in cities, but successful in towns and villages. The following figures, in regard to electric undertakings, are for the average of the years 1898 to 1902: There were 3 cities, 23 towns and 8 villages owning and operating electric light plants in the province. The capital provided for electric lighting by cities amounted to $81,573, by towns $537,355 and by villages $121,565. The average annual income from electric lighting plants in cities was $7,613, with working expenses at $18,418; the average income for towns was $134,803, and working expenses $107,581, and in villages the average income was $11,247 and working expenses $7,893.

OTTAWA, ONT.—According to the report of the officers carrying out the electric light inspection act, there were, last year, 324 plants in the Dominion, with 14,780 arc lights and 1,212,861 incandescent lights. Taking the arc light as equal to 10 incandescent lights, the country had on the 30th of June last, 1,360,661 lights in use. This is an increase of 236,865 lights in the twelve months, or over 21 per cent. The increase since 1898 in arc lights has been 42 per cent and 161 per cent in the number of incandescents. The province of Ontario has 203 of the 324 plants in use. It has considerably more than one-half the total number of arc lights and 47 in each hundred on the incandescents. The province of Quebec has 53 plants, 3,853 arc lights and 409,503 incandescents. The plants in Quebec, however, are much larger than those of Ontario, the average of Quebec's 53 plants being 15,000 arcs and incandescents, and that of Ontario's 203 plants being 3,215 arcs and incandescents. The largest single plant in the Dominion is that of Toronto with its 170,000 lamps, arcs being reckoned at 10 incandescents. The next largest is that of the Lachine Rapids Company, Montreal, with 158,503, and the third in size is that of the Ottawa Electric Company, Ottawa, with 111,927 lights. All the other provinces have made considerable progress, but British Columbia shows the largest proportional increase of any of the divisions of Canada.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Articles of incorporation have been filed in San Bernardino County for the Holton Interurban Railroad Company, with its principal place of business in Redlands. Its capital stock is $200,000, of which amount $12,500 has been subscribed. The directors are W. F. Holt, C. S. Lombard, C. A. Barker, A. G. Hubbard and M. M. Phiney.

CHICAGO, ILL.—Judge Grosscup has ordered an examination into the financial status between the Chicago Union Traction Company and its underlying companies. Henry W. Bishop, master in chancery, was selected by the court to conduct the examination.

SHELBYVILLE, IND.—Motormen and conductors on the Indianapolis, Shelbyville & Southeastern Traction Company were given an increase in wages from 18 cents to 20 cents an hour beginning with the new year. The working hours were shortened from eleven to nine and one-half.

LEBANON, IND.—Wallace B. Campbell, promoter of the Anderson-Lebanon Traction Railway has been granted a fifty-year franchise to build into this city. Mr. Campbell has secured franchises in all the cities along the proposed line, and will now turn his attention to securing the right of way. He will soon organize the company, and says the money to build the road is ready.

GLOUCESTER, MASS.—The Massachusetts Electric Companies are installing a new high-tension system for supplying current to all the lines included in their properties. There will be three steam turbine alternating-current central stations, which will supersede about 13 engine-driven direct-current stations scattered over the territory served. The lines north of Boston, including those of the Gloucester division, now receive power from 10 separate stations, 5 of which will be replaced by one steam turbine station, aggregating 9000 hp, and located at Danvers. The southern division is now operated from 11 direct-current stations, which will be superseded by 2 steam turbine stations, one of 1200 hp at Fall River, and one of 15,000 hp at Quincy Point.

WOODSTOCK, N. B.—An electric railway between Fredericton and Woodstock, New Brunswick, is projected. American capitalists will be interested in the enterprise. The new line will be used for carrying freight and passengers.

PRINCETON, N. J.—Surveys have been completed for the proposed electric railway between Princeton and Somerville, or Bound Brook, and the business arrangements are being taken up. It is understood that allied interests have a traction charter under which the road can be built, but T. G. Kitchin, of Trenton, N. J., who has represented the promotors in several business transactions, says that a steam railroad charter will be used. The road will be about 17.8 miles long, and will connect at its northerly terminus with a line to be built between Somerville and Morristown, if the present plans are carried out.

MINEOLA, N. Y.—The Cleveland Construction Company, of Cleveland, Ohio, is placing many of the contracts for the equipment of the new power station of the New York & Long Island Traction Company, which is to be erected at Rockville Center, on the line of the road. The company is now extending its South Shore division from Rockville Center through Linbrook, Valley Stream, Rosedale and Springfield to the terminal of the Kings County Elevated Railroad in New York City.

TOLEDO, OHIO.—The Toledo & Fort Wayne Railway Company has been incorporated at Columbus with a capital stock of $100,000.

NORTH AMHERST, OHIO.—The Lorain & Southern Electric Railway Company has been organized here to build an electric railway from Lorain to Oberlin through this place. The distance is 15 miles. The road will be used for hauling freight and stone trains, as well as for passengers, electric locomotives supplying the motive power. It is stated that the Westinghouse Company will furnish the electric locomotives and entire electrical equipment.

OGDEN, UTAH.—It is stated that a deal is pending for the acquisition of the Ogden street railway system by the Consolidated Light & Railway Company, of Salt Lake City. This would give the latter company control of every foot of electric railway in the state. The local management has decided upon numerous improvements if the Salt Lake Company does not secure control of the system.

MONTREAL, QUE.—The Montreal Street Railway Company, in strengthening its operating staff is recalling former employes that have been serving with other companies. Mr. Ludger Trudeau, who has been acting as manager of the Street Railway Company of Alexandria, Egypt, has arrived in Montreal to again assume a position with the company he formerly served there. Three years ago Mr. Trudeau became manager of the street railway in Bordeaux, France, and while in that employ he received his appointment to the Egyptian concern.

OTTAWA, ONT.—Canadians are reaching out for electrical enterprises in many foreign fields. A number of Nova Scotia capitalists recently visited the Island of Trinidad and the opportunity there offering proved so tempting that it was decided to take over the tramways in the town of Port of Spain, and operate them upon modern lines. The tramway in question is 12½ miles in length. The company, which has been formed under the name of the Trinidad Electric Company, secured the plant at the figure of $1,200,000. It has already instituted a new plant and has put a Canadian at the head in the person of Mr. F. W. Teale, who was formerly with the Boston Tramway Company.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC TYPEWRITER COMPANY, of Norfolk, Va., has been incorporated. Mr. H. H. Little is president. The capital stock is $50,000.

THE STANDARD LIGHT & HEAT COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $100,000 by James T. Morgan, Le Roy S. Lewis and Louis G. Morton.

THE ESSINGTON ROTARY STEAM ENGINE COMPANY has been incorporated at Camden, N. J., with a capital of $300,000. The names of the incorporators are Henry C. Essington, James W. Irwin and Almon P. Wint.

THE CIRCUIT-PROTECTING RELAY COMPANY, of Kendall, Orleans County, N. Y., has been incorporated to manufacture telegraph instruments. The capital stock is $3000, and the directors are S. R. Wright, M. J. Storer and John Elliott Morton.

W. H. COVERDALE & COMPANY, of New York City, have been organized to carry on the business of civil, electrical and mechanical engineering, the capital stock being $25,000. The directors are W. H. Coverdale, C. F. Keene and G. C. Atkins, of New York City.

THE ELECTRIC CYCLONE AMUSEMENT COMPANY, of St. Louis, Mo., has been incorporated to operate electrical mechanical devices for amusement. It has a capital stock of $100,000, one-half paid. The incorporators are Edgar P. Voll, J. J. Wehrle, A. E. Hoffman, Myer Morris and John H. Goodfellow.

THE HUTCHISON ACOUSTIC COMPANY, of New York City, was incorporated this week with a capital of $500,000, to manufacture special telephonic mechanisms. The directors are M. R. Hutchison, of New Rochelle; H. B. Babbitt, of Washington, D. C.; and K. M. Turner, J. H. Devlin and J. Shirley Eaton, of New York City.

OBITUARY.

MR. ERNEST THOMPSON.—We regret to announce that Mr. Thompson, partner in the firm of Nalder Bros. & Thompson, manufacturers of ammeters, voltmeters and various instruments, London, England, died recently, after a long and painful illness. Mr. Thompson had been quite unable to attend to business for about a year, since which time, however, he had undertaken a voyage around the world in the hopes of restoring his health. He was in New York about a year ago. On his return to London, however, and on attempting to take up business, it was found that he was quite unequal to the task, and rapidly got worse. Mr. F. H. Nalder, who is well known in America, as well as in England, will continue the business, and we are sure that many readers of our papers will extend their sympathy to the family and to Mr. Nalder.

MR. W. O. GARRISON.—We noted briefly last week on telegraphic advices the death of Mr. W. O. Garrison, president of the Columbia Incandescent Lamp Company, of St. Louis, and a member of the well-known Missouri family of that name. It is with deep regret that we have thus seen pass away a young man of such ability and sterling worth. He was the eldest son of Daniel E. Garrison and a grandson of the late Oliver Garrison, famous as one of the leaders in building the Missouri Pacific Railroad. He was born in St. Louis 42 years ago, and after graduation went into business there, marrying about 13 years ago Miss Edith Hendel, a granddaughter of the late Jesse Arnott. For several years past he had been prominent in the electrical field, and most highly esteemed by all who met him or knew him intimately. He had been in poor health for a number of months, being confined to his bed since early in September on account of trouble with his leg and hip. The complaint appeared at first to be sciatic rheumatism, but afterwards developed into inflammation, as a result of grippe. The family did not, however, until very recently, take a serious view of the case, as he had been able to conduct the business of the Columbia Company in his wonted vigorous way, while in bed. Just lately, however, he showed a grave weakness of the heart, and this on Sunday evening, January 17, was the direct cause of his death. He was active as well in social as in business affairs, being a member of the Country Club, the Mercantile Club, and other leading social and commercial organizations. His wife survives him. His brother, Mr. A. C. Garrison, formerly connected with the Columbia Company, will again give it his attention and has succeeded to the presidency, to which he will now devote his entire time and attention.

EDUCATIONAL.

A VALUABLE GIFT TO LAFAYETTE COLLEGE.—The Henry W. Oliver chemical and metallurgical library of Lafayette College, Easton, Pa., has received as a gift from a generous friend all the pamphlets, about 3000 in number, belonging to the library of the late Professor Johannes Wislicenus, of the University of Leipsic, Germany. Prof. Wislicenus was a famous chemist. He was a pioneer in the study of lactic acid and led in the work which gave to us our present knowledge of stereoisomerism. This library represents the collection of fifty years of great activity and will be a valuable addition to the Oliver library.

COLUMBIA UNIVERSITY, NEW YORK.—At a recent meeting of the trustees of Columbia University, it was voted to fix the annual fee for tuition in the Schools of Applied Science and in the College of Physicians and Surgeons at $250 from and after July 1, 1904. The annual tuition fee in these schools is at present $200. Since the present fee was fixed the equipment of Columbia University in these departments has been greatly increased, and the number of instructors multiplied. The cost of giving the instruction in applied science and in medicine has steadily grown year by year and is now not less than twice the amount received from fees for tuition. The tuition fee at the Massachusetts Institute of Technology is already $250, and the fee for New York students who attend the Stevens Institute of Technology at Hoboken is $225. The per capita cost of instruction at Columbia is believed to be greater than that at either of the institutions mentioned.

THE AMERICAN SCHOOL OF CORRESPONDENCE has adopted a method of advertising which, even if it is profitable to them, is a very good thing for students of electricity. As readers of the technical periodicals have doubtless noted, that institution has arranged under one cover four of the forty-five text books which it uses in teaching its course in Electrical Engineering, and is selling the whole for seventy cents. The four chosen are: "Elements of Electricity," and "The Electric Current," both by L. K. Sager, S. B., LL. B.; "Electric Wiring," by H. C. Cushing, Jr.; and "Storage Batteries," by F. B. Crocker, E. M., Ph. D., Professor of Electrical Engineering at Columbia University. They are all crisply and concisely written and well condensed. There are incorporated in the volume several tables and a whole lot of reference data, which would be of considerable value to one engaged in any electrical line. The section on Storage Batteries, by Prof. Crocker, gives just the sort of storage battery information and tells it in just the sort of way that will reach the practical telephone man, who should at least have a good idea of this appliance which is now so common in these days of central energy. There are 256 pages in the volume.

PERSONAL.

MR. A. G. BRIGGS, of Alameda, Cal., has now been appointed superintendent of the Merced Falls, Cal., Gas & Electric Company.

MR. J. H. ROSENTHAL, managing director of Babcock & Wilcox, Limited, of London, has sailed for home after a brief sojourn in the States.

MR. GEORGE WESTINGHOUSE is a passenger on the North German Lloyd liner *Kaiser Wilhelm II*, which left New York for Europe Jan. 26.

MR. H. HINE, president of the Guanajuato Electric Light & Power Company, Mexico, is expected back in New York next week from Colorado Springs.

GEORGE A. FERNALD & COMPANY, of Boston, Mass., has bought a controlling interest in the Stoughton, Mass., Gas & Electric Light Company.

MR. ROBERT W. BLACKWELL, of the British electrical engineering and contracting firm of Blackwell & Company, Limited, has sailed for Europe after a short visit to the States.

MR. ALBERT E. DOE, JR., formerly with Norcross Bros. Company, of Boston, has been appointed New England representative by the Thomas H. Dallett Company, of Philadelphia.

MR. H. F. PARSHALL, the well-known American electrical expert, who has been located in London for some years past left New York Jan. 26 for Europe on the *Kaiser Wilhelm II* after a brief stay on this side.

MR. E. A. CAROLAN, manager of the London offices of the General Electric Company, and a director of the British Thomson-Houston Company, Limited, has sailed for Europe after several weeks' visit to this side.

MR. W. S. CHASE, sales manager of the National Acme Manufacturing Company, of Cleveland, Ohio, has taken passage from New York for England and the continent on a business trip which will last about two months.

REAR ADMIRAL CAPPS, Chief of the Navy Bureau of Construction and Repairs, was given a reception at the Engineers' Club last week, when there was a large attendance in spite of the wretched weather. Many electrical men were present.

MR. H. W. SPANG, the veteran electrician and lightning-rod expert has contributed to the *American Gas Light Journal* an interesting article on the unscientific electrical engineering that results in the electrolytic destruction of underground pipes.

MR. CHAS. E. COLLINS, the hydraulic engineer, the Drexel Building, Philadelphia, is preparing plans for the Hoosick River power plant of the Schaghticoke Electric Power Company, of Schaghticoke, N. Y., which proposes to develop about 3500 hp.

MR. JOHN C. McDONALD, wire chief of the New York Telephone Company at the Tremont exchange, has worked out a "safe" third rail method or attachment which he is now having patented. He has rigged up a 30-foot track at his home and may presently experiment on the Interborough tracks.

PROF. A. G. BELL has arrived from Italy with the body of James Smithson from Genoa, where it has lain many years. It was taken on the U. S. S. *Dolphin* to Washington, where it has been interred at the Smithsonian Institution, which Mr. Smithson gave to this country. Mr. Smithson died in 1829.

MR. JOHN E. STARR, for some time past connected with Arthur Koppel, 66 and 68 Broad Street, New York, is about to leave for Russia. He will establish himself at Revel, on the Baltic Sea, where he will conduct an agency for the handling of American electrical equipment and supplies, also machine tools.

PROF. J. BLONDIN has resigned as editor of *Eclairage Electrique* to become editor of a journal shortly to be issued, to be named *Revue Electrique*, and to be published by Gauthier-Villars. The journal will resemble the Digest in plan, its purpose being to review foreign current electrical periodical literature.

MR. ROBERT H. HASSLER, formerly with the Westinghouse Electric & Mfg. Company and more latterly electrical engineer with the Waverly electric automobile interests, etc., has now become connected with the Marion Motor Car Company, of Indianapolis, which is going into the gasoline automobile field.

MR. FRANCIS F. COLEMAN contributes to the *Manufacturers' Record*, of Baltimore, Md., a very interesting article on the recent electrical development of the South, citing a great many instances of new plants, new work, etc. The prosperity of that large and important region has stimulated electrical enterprises of all kinds.

MR. F. A. LA ROCHE, the well-known electrical manufacturer and engineer, has of late found himself overwhelmed with the new business work due to his connection as manager with the American Darracq Automobile Company. He is, however, still deeply interested in electrics when not winning races or challenging competitors to produce as good machines.

MR. JAMES F. CUMMINGS, who recently secured the contract for the laying of the conduit for the St. Petersburg municipal telephone and telegraph lines, is now in Cincinnati, Ohio. He is expected in New York early next week at the Hotel Imperial. The conduit is being manufactured at the Raritan, N. J., plants of the National Fireproofing Company. Further Russian contracts are pending.

PROF. CURIE and his wife deny the statement that they intend to visit America. It is a pity they cannot come over. They would receive a royal welcome from admiring and appreciative citizens of this country in general, and from the scientific world in particular. There is no jealousy here in regard to their splendid work, which has added so greatly to the scientific glory of France.

MR. A. N. BRADY, the electric lighting magnate is largely interested in a theatre at Albany, N. Y. When he heard of the Iroquois Theatre fire in Chicago, he went to the Commissioner of Public Safety and insisted that it should be closed until brought thoroughly up to the best insurance standards of the time. It is a pity there are not more theatre owners as public spirited and prompt to act.

MR. RALPH D. MERSHON, the consulting electrical engineer, is at an early date to give the New York Electrical Society an address on the subject of the gas engine for central station work. This will be a very interesting topic for a great many of the members. Mr. Mershon has made an intimate study of the gas engine and takes an opportune time to give publicity to his views and ideas.

MR. JAMES ROSS, of Montreal, president of the Mexican Light & Power Company, Limited, which is building a huge plant at Necaxa to generate power for transmission to Mexico City and the El Oro mining district, has left for the southern republic in order to inspect the progress made in the work. He is accompanied by Mr. F. L. Wanklyn, formerly vice-president and general manager of the Montreal Street Railway.

MR. RUDOLF WIESER has been commissioned by the Mexican-American Company, 49 Wall Street, New York, to look over the ground with a view to constructing an electric railway between Guadalajara and Lake Chapala—the Saratoga of Mexico. The distance is about 40 miles. The Mexican-American Company also proposes to install some lighting plants in the State of Jalisco. E. H. Talbot is president of the company.

MR. HERBERT LAWS WEBB, who has been away from this country for several months, is again in New York for a time. He has been doing considerable work in England as a telephone expert and consulting engineer. It will be remembered that he was connected for some years with the New York Telephone Company. Mr. Webb is however well known in England, the family being an old one in electrical affairs. He is a nephew of Sir W. H. Preece, F.R.S.

MR. A. M. MATTICE, who is prominently connected with Westinghouse interests and is the chief engineer of the Westinghouse Machine Company, received a high compliment from President Kafer, of the Engineers' Club, last week, in a speech before that body. Mr. Kafer, who was at one time professor of mathematics at the Naval Academy, spoke of Mr. Mattice as by far the most brilliant student there in many years, if not indeed during the whole existence of the Academy. Mr. Mattice for some time was an assistant to Admiral Melville.

MR. CHARLES T. YERKES has sailed for England on the *Kaiser Wilhelm II*, after an extended visit to this side. Shortly after his arrival in London it is expected that the contract will be awarded for the motor equipments to be used in the extensive underground and surface electric traction system which the Underground Electric Railways Company of London, Limited, of which Mr. Yerkes is chairman, and in which the Speyers, the New York Life and Mutual Assurance and other prominent American interests are largely concerned. The motor equipment contract will represent an expenditure of some $3,000,000.

MR. W. C. GOTSHALL.—At the annual dinner of the Lehigh University Club, of New York, at the New York Athletic Club, last week, W. C. Gotshall, president of the Port Chester Street Railway Company, told the guests that Lehigh should establish a chair of railroad engineering or transportation because of the great demand for men schooled in the intricate knowledge of railroad building and operation that has grown up in the past decade. The universities to-day, said Mr. Gotshall, do not appreciate the necessities of every day commercial life. Mr. C. O. Mailloux, who spoke eloquently on the same general topic, has been one of the lecturers lately at Lehigh, with much acceptability.

PROF. A. H. PHILLIPS.—In recognition of the service of Prof. Alexander H. Phillips, of the chemistry department of Princeton University, "the first American mineralogist to extract radium from an American ore," a gift of twelve and a half grains of radio-active barium chloride will be presented to the university during this spring. Following the recent extraction of radium from carnolite by Prof. Phillips, a company has been formed in Buffalo, N. Y., for the purpose of producing it at a reasonable price. The first product turned out will be donated to the university by Stephen J. Lockwood, a Princeton graduate and organizer of the Buffalo Company.

MR. T. H. BAILEY WHIPPLE has reurned to the Sawyer-Man Company, and the position which he left last summer in order to take a part in the reorganization of the sales department of the Nernst Lamp Company of Pittsburg. Mr. Whipple is an old hand in the commercial end of the electric lighting field. He was general sales agent with the Buckeye Electric Company of Cleveland, Ohio, and held a similar position with the Jandus Electric Company which was an off-shoot of the Buckeye Electric Company. During his connection with these two companies he established most of their agencies throughout the United States. Early in 1903 Mr. Whipple went to the Sawyer-Man Electric Company, with which he remained until he was called as above noted to the Nernst Lamp Company.

Trade Notes.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, Ohio, through its connection with the Ohio Malleable Iron Company, of the same place, is now in the field soliciting orders for high grade malleable castings.

LAMP TESTING BUREAU.—It is proposed by the Lamp Testing Bureau, of New York City, to change its name, and Mr. John W. Lieb, Jr., its president, has given legal notice of the intended plan to call it the Electrical Testing Laboratories.

ASBESTOS THEATRE CURTAINS.—We have received from the H. W. Johns-Manville Company samples of the cloth used by it in its excellent asbestos theatre curtains, accompanied by a leaflet on the subject, which shows actual tests being made in a New York theatre, and gives some most interesting data on this important subject.

THE INTERNATIONAL BRASS & ELECTRIC COMPANY, 76 Beekman Street, New York, has issued its 1904 catalogue of the line of goods manufactured by it. The catalogue contains illustrations and price lists of induction coils, automobile coils, sparkers, switches, connectors, etc. The company manufactures these articles and many others, and carries goodly sized stocks.

THE AMERICAN WATER SOFTENER COMPANY, of Philadelphia, has opened a branch office in the Outlook Building, Columbus, Ohio, in the immediate charge of Mr. W. H. P. Fisher, general sales agent for the company, and Mr. A. C. Tomlinson, manager of the Columbus office, who for some time has been the assistant manager of the Philadelphia office.

THE CENTRAL ELECTRIC COMPANY, Chicago, is starting in 1904 with renewed enthusiasm to push the sale of D. & W. enclosed fuses and safety devices. The company makes the statement that the popularity of D. & W. material has been steadily growing and with a constantly widening field ahead there is every reason to believe that the coming year will witness very largely increased sales.

INDICATOR WORK TAUGHT BY MAIL.—The Indicator Instruction Company, of Scranton, has been formed to give indicator instruction by mail under Mr. A. C. Lippincott, well known as an indicator expert and the inventor of the Lippincott planimeter for measuring indicator cards. Everything relating to indicator work will be taught, including the subjects of the planimeter, reducing motions, care and repair and testing of indicators. Indicators will be loaned to the students of the course.

THE BEARDSWORTH ENGINEERING & MACHINERY COMPANY, Cleveland, Ohio, has been formed to act as electrical engineer and selling agent for electrical equipment. The company will make a specialty of selling and re-installing complete second-hand power plants that are fully guaranteed by those who wish to dispose of the same. It has a number of complete plants for sale in various parts of the country. Parties having steam and electrical equipment too small for their present requirements can make advantageous exchanges through this company.

PELTON WHEELS.—A large order for Pelton water wheels is being completed for the Columbia Improvement Company, near Tacoma, Wash. The installation consists of four Pelton units, aggregating 31,000 hp operating under an 850-foot head. These are the largest water wheel units in the world, with the exception of those at Niagara Falls, and demonstrate the abilities for handling especially large orders. An 88-page illustrated catalogue containing complete data in reference to hydraulic power is sent free on application to the Pelton Water Wheel Company, 130 Main Street, San Francisco, or 141 Liberty Street, New York.

NEW STURTEVANT PLANT.—One of the features of the new plant of the B. F. Sturtevant Company, at Hyde Park, Mass., peculiarly indicative of the permanent character of the new works now under construction, is the steam tunnel 4½ feet in width and 6½ feet high, extending from the power plant to the most remote part of the manufacturing buildings, a total distance of about 800 feet. This tunnel, which is of concrete construction, will not only accommodate all of the steam piping, but also the electric wires for power, light, telephone, standard time clock, and other service, together with oil, hot water and other pipes for general distribution to the various buildings of the plant. None of these features of the equipment will be carried above ground at any outdoor point. While the expense of such an installation is necessarily large, the convenience of access for changes and repairs will in the future much more than offset any fixed charges thereon.

THE SPRAGUE ELECTRIC COMPANY'S New York office and Watsessing factory forces held their annual bowling tournament and banquet at Smith's Hotel, Roseville, N. J., on Jan. 16, 1904. That it was a grand success goes without saying. Besides the "boys" several of the officers of the company and many heads of the departments were present. Four bowling matches arranged on a "sliding scale basis" were rolled. The representatives of the office force came out victorious in all of the matches after hard-fought battles with their opponents, the representatives of the factory, who acted as hosts on this occasion. It may be noted that although they were beaten in the matches, it was the consensus of opinion of all present that as hosts, Mr. Charles Noll and his confreres were without equals. After the matches everybody sat down to a banquet and tackled the uniquely gotten up bill of fare in such a manner as if a thing as indigestion had not been heard of by any of the party. After the coffee had been served and the last "fuse" had been "blown," the toasts were "thrown into circuit." The voltage of the themes of these toasts was very high and the "circuit breakers" of laughter were continually being "tripped." Mr. Issertel, of the New York office, acted as toastmaster. He is the walking delegate of the Toastmasters' Union, and holds his job on merit.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 19, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

749,716. RAIL CONTACT SHOE; George W. Brady and Lawrence R. Jones, Wheaton, Ill. App. filed Jan. 26, 1903. The shoe has two diverging sides adapted to engage the corners of the rail where least ice is supposed to form.

749,775. ELECTROSTATIC RELAY; Dan. La Cour, Copenhagen, Denmark. App. filed Feb. 7, 1903. An electroscope charged from a local source of electricity effects by its movements the closing or interruption of an electric circuit.

749,785. BATTERY-PLATE; Oskar Frank, Detroit, Mich. App. filed May 2, 1903. (See page 225.)

749,795. TROLLEY STAND; James Kermath, Detroit, Mich. App. filed Oct. 9, 1903. Details of the stand whereby it is supported close to the top of the car and offers no hindrance in passing under viaducts.

749,798. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed Dec. 19, 1900. (See page 226.)

749,813. PORTABLE X-RAY APPARATUS; Eugene W. Caldwell, New York, N. Y. App. filed Jan. 16, 1903. An organization of the complete outfit with parts arranged for quick adjustment.

749,814. RELAY DEVICE; John P. Downs, Cleveland, Ohio. App. filed May 7, 1902. Details.

749,824. TELEPHONE-EXCHANGE; Nils Emel Norstrom, Chicago, Ill. App. filed Nov. 23, 1900. (See page 226.)

749,835. ELECTROMECHANICAL SWITCHING MECHANISM; Walter J. Bell, Los Angeles, Cal. App. filed May 29, 1903. A motor to move a switch point is connected and disconnected by a clutch controlled by an electro-magnet.

749,842. BURGLAR ALARM FOR SAFES; Henry R. Cassel, London, Eng. App. filed May 3, 1902. A pressure of air is maintained in the safe and a circuit closer therein is actuated when the pressure is altered.

749,843. PROCESS OF EXTRACTING PRECIOUS METALS BY ELECTROLYSIS; Henry R. Cassel, New York, N. Y. App. filed Oct. 25, 1902. (See page 225.)

749,844. APPARATUS FOR EXTRACTING PRECIOUS METALS BY ELECTROLYSIS; Henry R. Cassel, New York, N. Y. App. filed Oct. 25, 1902. (See page 225.)

749,855. PROCESS OF PRODUCING ELECTRODES FOR STORAGE BATTERIES AND ELECTRODE; Frederick A. Feldkamp, Newark, N. J. App. filed May 19, 1903. (See page 225.)

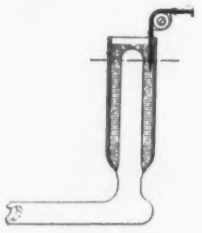
749,867. METHOD OF SECURING ELECTRIC WIRES; Alexander Kline, Jersey City, N. J. App. filed March 31, 1902. The tie-wire used to fasten a conductor in the groove of an insulator is a flat strip which can be wound around the conductor without the use of tools and thus prevents the liability of damaging the conductor by the plier.

749,916. TROLLEY FOR OVERHEAD ELECTRICAL CONDUCTOR SYSTEMS; Eugenio Cantono, Rome, Italy. App. filed Aug. 3, 1903. Details.

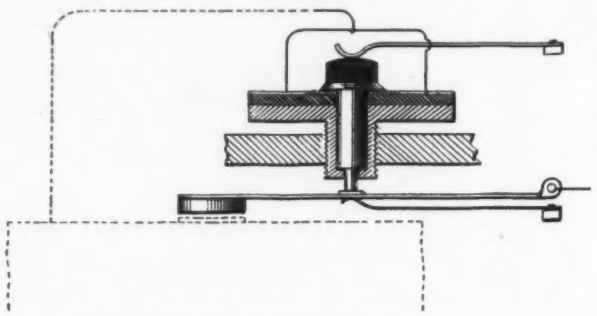
749,919. HANDLE FOR SNAP SWITCHES; Charles A. Clark, Hartford, Conn. App. filed Jan. 3, 1903. The handle contains an internally threaded movable bushing held telescopically by a spring; when it is screwed upon the spindle of the switch, the tension of the spring holds the cap, if it is a surface-switch, or the plate, if it is a flush switch, tightly in position.

749,939. RAILWAY SIGNALING APPARATUS; John F. Mickey, Frank T. Bailey, and Joseph J. Noppenberger, Baltimore, Md. App. filed Aug. 1, 1903. Details.

749,949. INDICATING DIAL FOR SNAP ELECTRIC SWITCHES; Charles G. Perkins, Hartford, Conn. App. filed Oct. 29, 1903. The dial is secured to the spindle sleeve by means of lugs engaging notches in the dial, the engagement being accomplished by an edgewise movement of the dial.



749,999.—Electrode for Electric Tube Lamps.



750,041.—Vibratory Circuit Controller.

749,952. LAMP SOCKET; Duny A. Schutt, Peru, Ind. App. filed Jan. 28, 1902. Details.

749,977. TELEPHONE-HOOK SWITCH; Ernest E. Yaxley, Chicago, Ill. App. filed June 12, 1901. (See page 226.)

749,982. ELECTRICAL SIGNALING SYSTEM; Henry P. Clausen, Chicago, Ill. App. filed Dec. 19, 1901. A circuit arrangement whereby a telephone signaling lamp will always light up and respond to a signal regardless of whether the circuit of the lamp is closed for some time or only for an instant.

749,988. CABLE CLIP; Otto C. Hoffman, Chicago, Ill. App. filed July 31, 1902. A strap with a novel form of clamping buckle on the end.

749,989. CABLE CLIP; Otto C. Hoffman, Chicago, Ill. App. filed Dec. 8, 1902. A modification of the preceding device.

749,998. ELECTRIC TUBE LAMP; Daniel McF. Moore, Newark, N. J. App. filed Jan. 22, 1903. An electrode for a tube-lamp consisting of a coating of conducting material spread upon the inner surface of the tube and in intimate connection with a leading-in wire.

749,999. ELECTRODE FOR ELECTRIC TUBE LAMPS; Daniel McF. Moore, Newark, N. J. App. filed Feb. 26, 1903. The end of the tube where the connection is made is placed in a holder containing mercury which operates as the conducting cap and avoids using an adherent coating of graphite.

750,012. FIRE ALARM MECHANISM; Leonidas G. Woolley, Kenton, Ohio. App. filed April 27, 1903. Various details.

750,013. FIRE ALARM SYSTEM; Leonidas G. Woolley, Kenton, Ohio. App. filed July 6, 1903. Relating to the preceding patent.

750,038. ATTEMPERATING DEVICE; Milton H. Shoenberg, San Francisco, Cal. App. filed March 16, 1903. A coupling for controlling the admission of air under the pressure to a dental tool and at the same time for regulating the heating of the air.

750,039. RUHMKORFF COIL; Richard Varley, Providence, R. I. App. filed Aug. 21, 1903. The circuit is broken at the vibrator by the joint action of the core of the coil and an auxiliary magnet, the entire vibrator is also bodily removable, being held in place by spring-clamps.

750,040. VIBRATORY CIRCUIT CONTROLLER; Richard Varley, Providence, R. I. App. filed Oct. 19, 1903. The vibrator makes contact with three different points on the back stroke, thus ensuring a low resistance connection.

750,041. VIBRATORY CIRCUIT CONTROLLER; Richard Varley, Providence, R. I. App. filed Oct. 19, 1903. A construction whereby the primary circuit is opened and closed more than once during each to and fro excursion of the vibrator.

750,093. ELECTRIC-RESISTANCE FURNACE; Alfred H. Cowles, Cleveland, Ohio. App. filed Nov. 20, 1902. (See page 225.)

750,094. PROCESS OF SMELTING MATERIALS AND PRODUCING CARBID; Alfred H. Cowles, Cleveland, Ohio. App. filed Oct. 20, 1903. (See page 225.)

750,098. MOTOR; Bertram J. Delzeit, Philadelphia, Pa. App. filed Oct. 31, 1903. A motor is supplied with current from a number of batteries, successively, the motor itself operating the switching device.

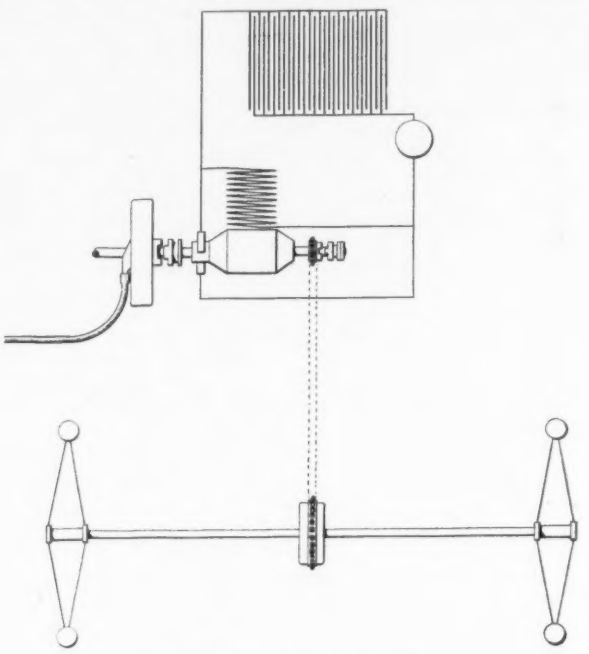
750,102. ELECTRICAL AUTOMOBILE; Thomas A. Edison, Orange, N. J. App. filed Jan. 9, 1903. A turbine steam engine is connected through a clutch with the motor armature shaft, so that by a proper adjustment of the motor circuits, it can be driven as a generator, part of the time, to charge a battery.

750,115. AUTOMATIC ELECTRIC PUMP; Francis L. Orr, Thurman, Iowa. App. filed Sept. 9, 1903. Details.

750,117. ELECTRICAL OPERATED AND CONTROLLED RAILWAY SIGNAL; Robert D. Peters, Knox, Ind. App. filed Nov. 21, 1902. Details.

750,132. ELECTROMAGNET; Illius A. Timmis and Edgar W. Timmis, London, England. App. filed June 19, 1903. A helix having a tapering central cavity and a tapering external surface, the armature having a tapering core and a tapering cylinder or rim.

750,139. ELECTRICAL CONTROLLER FOR RAILWAY CARS; Harlan P. Wellman, Ashland, Ky. App filed Nov. 19, 1903. The exhaust from the air brake system leads into the controller box to clear the latter of dust and to obtain a muffler effect.



750,102.—Electrical Automobile.

750,150. ELECTRIC FIRE ALARM; Joseph A. Barten and Samuel R. Sneeringer, Philadelphia, Pa. App. filed April 30, 1903. Details.

750,170. METHOD OF ELECTRIC HEATING; Alfred H. Cowles, Cleveland, Ohio. App. filed Nov. 5, 1902. (See page 225.)

750,179. ELECTRIC BLANKET; Charles Foglesong, St. Paul, Minn. App. filed Sept. 14, 1903. A blanket consisting of an asbestos layer and a woolen layer with heating resistance interposed between them.

750,180. METHOD OF CONTROLLING SPARK PRODUCTION; Lee De Forest, New York, N. Y. App. filed June 17, 1903. The method of creating sparks between normally inoperative sparking terminals which consists in increasing at will the condition of ionization of the medium between the sparking terminals.

750,181. DEVICE FOR CLEARING ICE FROM ANTENNAE; Lee De Forest, New York, N. Y., and Walter G. Clark, Seattle, Wash. App. filed June 17, 1903. Apparatus for sending a heating current through the antennae.

750,198. SOCKET FOR INCANDESCENT LAMPS; Owen E. Kenney, Toledo, Ohio. App. filed June 16, 1902. Details.

750,207. ELECTROMAGNETIC BRAKE; John S. Lockwood, Kansas City, Mo. App. filed June 23, 1902. A removable piece acting as a part of the magnet pole and the brake shoe is attached to the core of the magnet.

750,223. ELECTRIC BLOCK SYSTEM; Frederick C. Robinson, Farmington, Me., App. filed Aug. 22, 1903.

750,239. ELECTRICALLY HEATER SOLDERING IRON; William J. Bowen, Cleveland, Ohio. App. filed Aug. 17, 1903. Details.

750,244. FUSE FOR ELECTRIC CIRCUITS; Elwood C. Philips, Chicago, Ill. App. filed Jan. 9, 1903. A fuse plug in which the fusible strip extends around three-quarters of an annular groove, its ends being fixed to proper metallic connections.